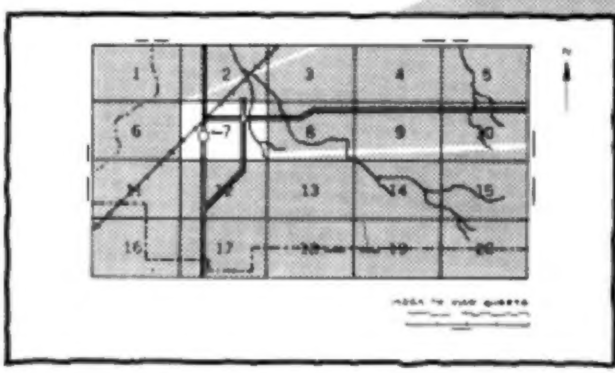
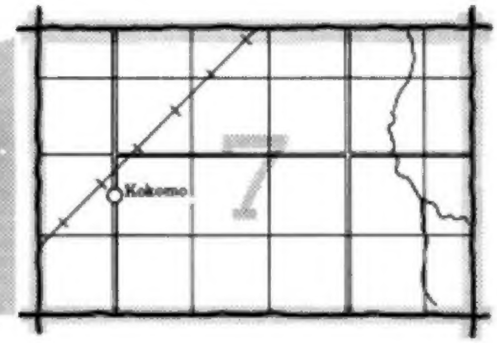
Soil survey of Thomas County Kansas

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Kansas Agricultural Experiment Station

HOW TO USE

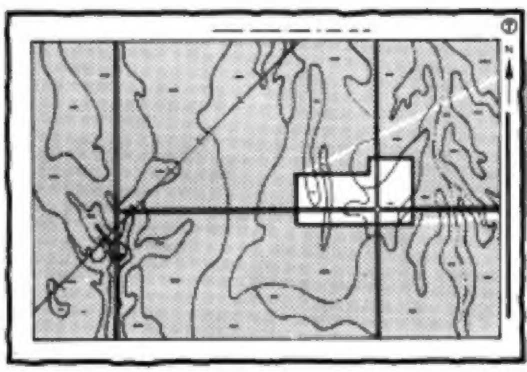
1. Locate your area of interest on the "Index to Map Sheets"

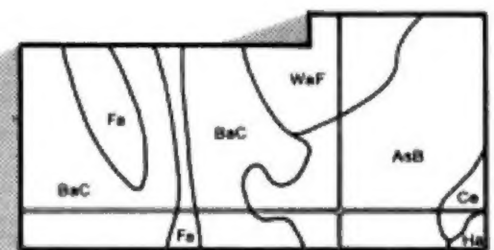




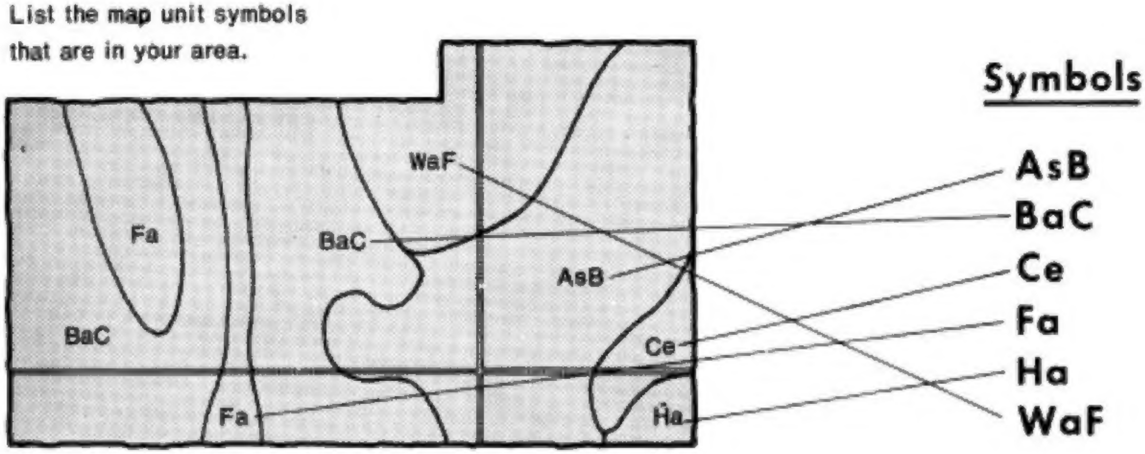
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



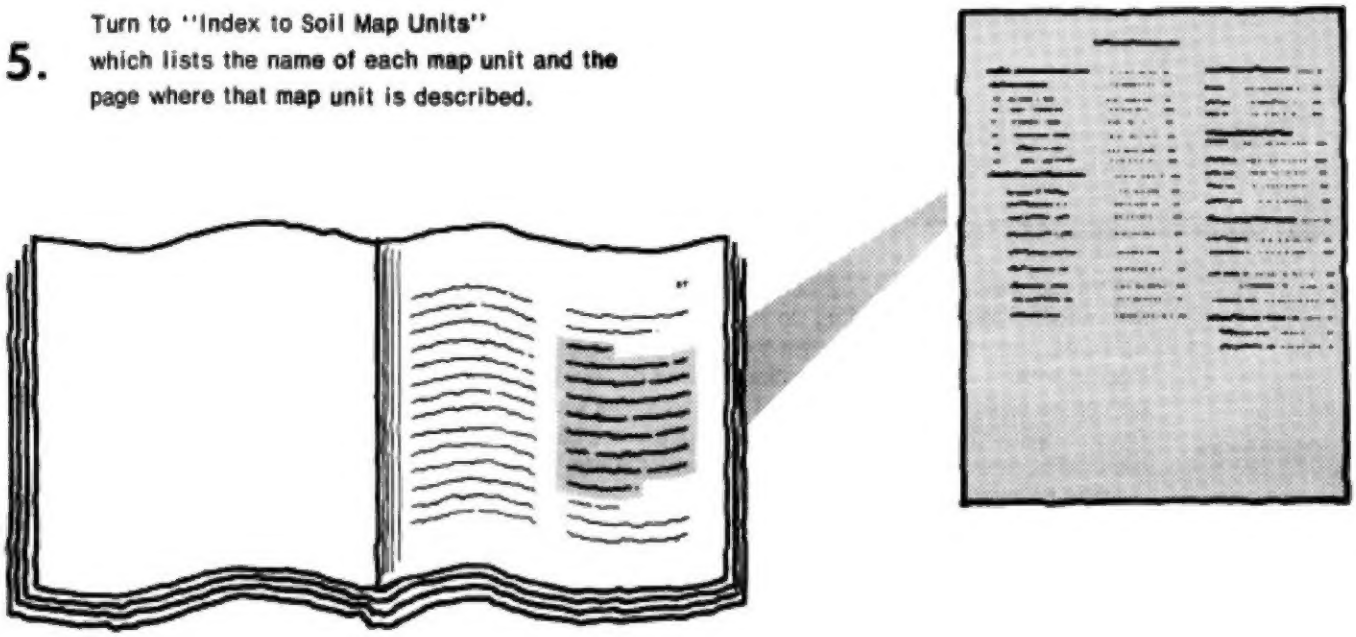


4. List the map unit symbols that are in your area.

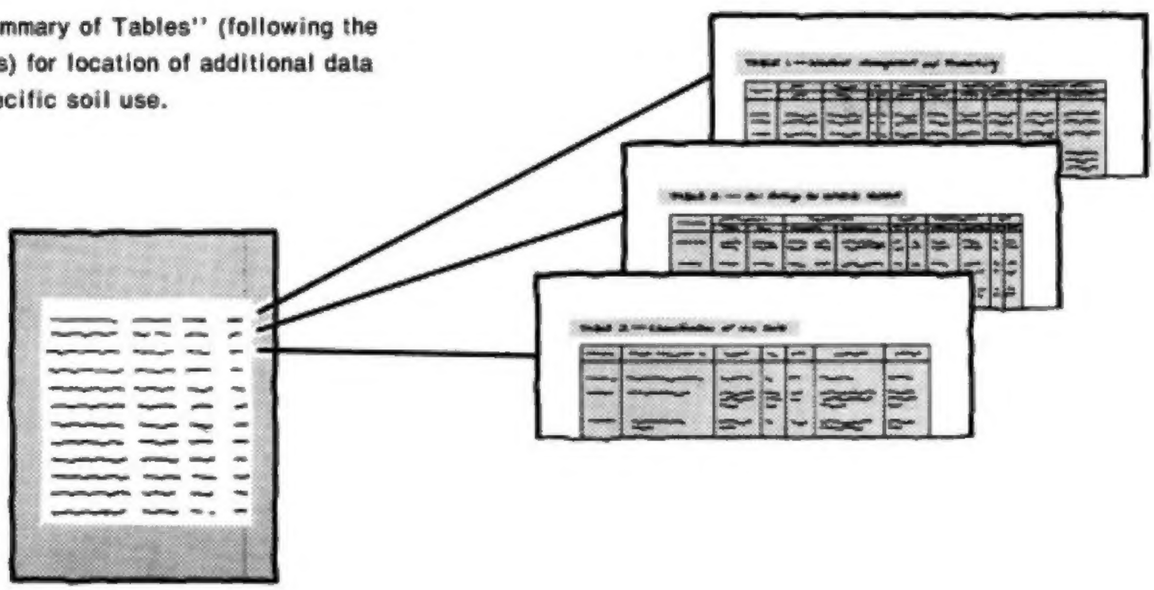


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Thomas County Conservation District. Major fieldwork was performed in the period 1973-1977. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Harvesting wheat on Keith silt loam, 0 to 1 percent slopes.

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Issued June 1980

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Foreword

This soil survey contains information that can be used in land-planning programs in Thomas County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

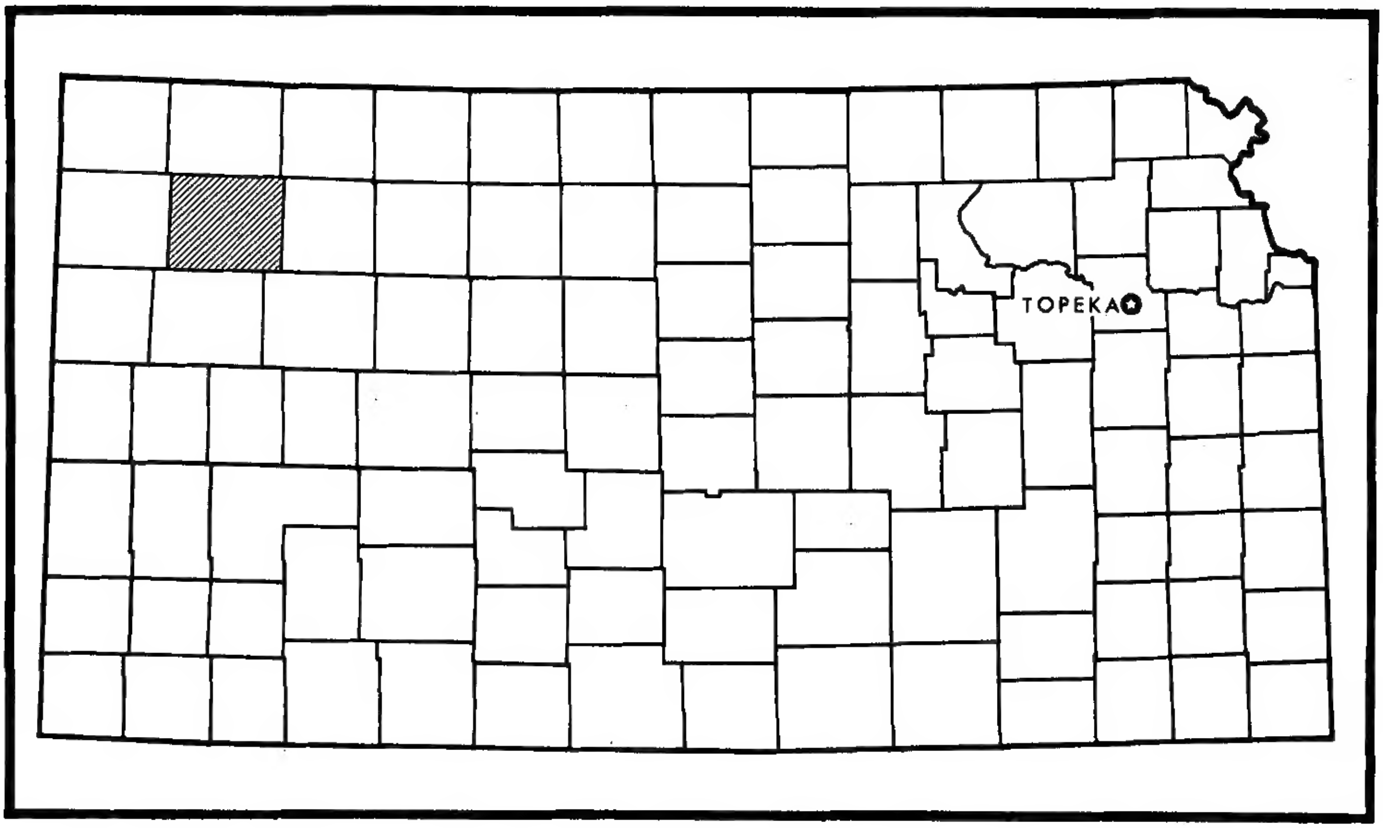
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie

John W. Tippie
State Conservationist
Soil Conservation Service



Location of Thomas County in Kansas.

Soil survey of Thomas County Kansas

By Wesley L. Barker, Raymond C. Angell, Elbert L. Bell,
Cecil D. Palmer, and C. F. Youberg, Soil Conservation Service

United States Department of Agriculture
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THOMAS COUNTY is on the high plains of northwestern Kansas. The county has a total area of 1,070 square miles, or 684,800 acres. In 1977, it had a population of 8,335 and Colby, the county seat, had a population of 5,222.

Thomas County was organized on October 8, 1885. The entire county is in the Central High Tableland land resource area. The soils are generally deep, friable, and nearly level and gently sloping. In a few areas along the major drainageways they are steeper. Elevation ranges from 3,475 feet above sea level in the west-central part of the county to 2,850 feet in the northeastern part along Prairie Dog Creek.

The county is drained by the Middle and South Forks of Sappa Creek, by Prairie Dog Creek, by the North and South Forks of the Solomon River, and by the Saline River. These easterly flowing streams originate either in Thomas County or in the adjoining county on the west.

The main enterprises in the county are farming and ranching. Wheat is the main dryland crop. Corn is the main irrigated crop.

General nature of the county

This section gives general information on the climate and the natural resources of the county.

Climate

By L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate of Thomas County is typical continental, as can be expected in the interior of a large land mass in the middle latitudes. It is characterized by large daily and annual variations in temperature. Winters are cold because of the frequent outbreaks of air from the polar region, but it lasts only from December through February. Warm summer temperatures last for about 6 months every year. Spring and fall are generally short. The elevation of Thomas County is generally higher than that of the counties to the south. As a result, the growing season is usually shorter.

The precipitation is usually inadequate for crop production because of the high rate of evaporation produced by warm temperatures and high wind velocities. Successful farming depends on irrigation, summer fallow, and extensive conservation measures. Dry conditions in the fall and winter limit the growth of wheat. As a result, wheat fields do not have a good plant cover in spring, when the windspeed is highest, and soil blowing causes heavy damage.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Colby in the period 1941 to 1970. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 28.4 degrees, and the average daily minimum temperature is 15.0 degrees. The lowest temperature on record, which occurred at Colby on February 12, 1899, is -31 degrees. In summer the average temperature is 73.4 degrees, and the average daily maximum temperature is 87.4 degrees. The highest recorded temperature, which occurred at Colby on July 25, 1940, is 113 degrees.

Of the total annual precipitation 15.34 inches, or 84 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 11.58 inches. The heaviest 1-day rainfall during the period of record was 5.01 inches at Colby on July 26, 1941.

Hail that falls during severe thunderstorms considerably damages crops. It frequently falls just prior to harvest, when the wheat crop is most vulnerable. Although these storms are local in extent, they occur frequently enough to be a major risk in Thomas County.

Average seasonal snowfall is 28 inches. The greatest snow depth at any one time during the period of record was 15 inches. On an average of 35 days, at least 1 inch

of snow is on the ground. The number of such days varies greatly from year to year.

The sun shines 70 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 15 miles per hour, in March.

Natural resources

Soil is the most widely used natural resource in Thomas County. If managed and used properly, it is a renewable resource. The purpose of this survey is to aid in maintaining and improving the value of the soil.

Other natural resources are underground water, sand and gravel, and oil. An adequate supply of sand and gravel is available for roads and other structures. Oil production has expanded in the 1970's but is still of minor importance.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Keith-Ulysses association

Nearly level and gently sloping soils that have a silt loam and silty clay loam subsoil; on uplands

This association is on broad uplands that are characterized by weakly defined drainageways and small depressions. It makes up about 82 percent of the county. It is about 77 percent Keith soils, 17 percent Ulysses soils, and 6 percent minor soils (fig. 1).

The deep, well drained Keith soils formed in loess on smooth broad uplands. Typically, the surface layer is dark grayish brown, friable silt loam about 11 inches thick. The subsoil is about 20 inches thick. The upper part is grayish brown, friable silty clay loam, and the lower part is light brownish gray, friable silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam.

The deep, well drained Ulysses soils formed in loess on low, convex ridges and side slopes. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is friable silt loam about 10 inches thick. The upper part is dark grayish brown, and the lower part is pale brown. The substratum to a depth of about 60 inches is light gray, calcareous silt loam.

The minor soils in this association are the occasionally flooded Goshen soils along upland drainageways, the moderately well drained Pleasant soils in upland depres-

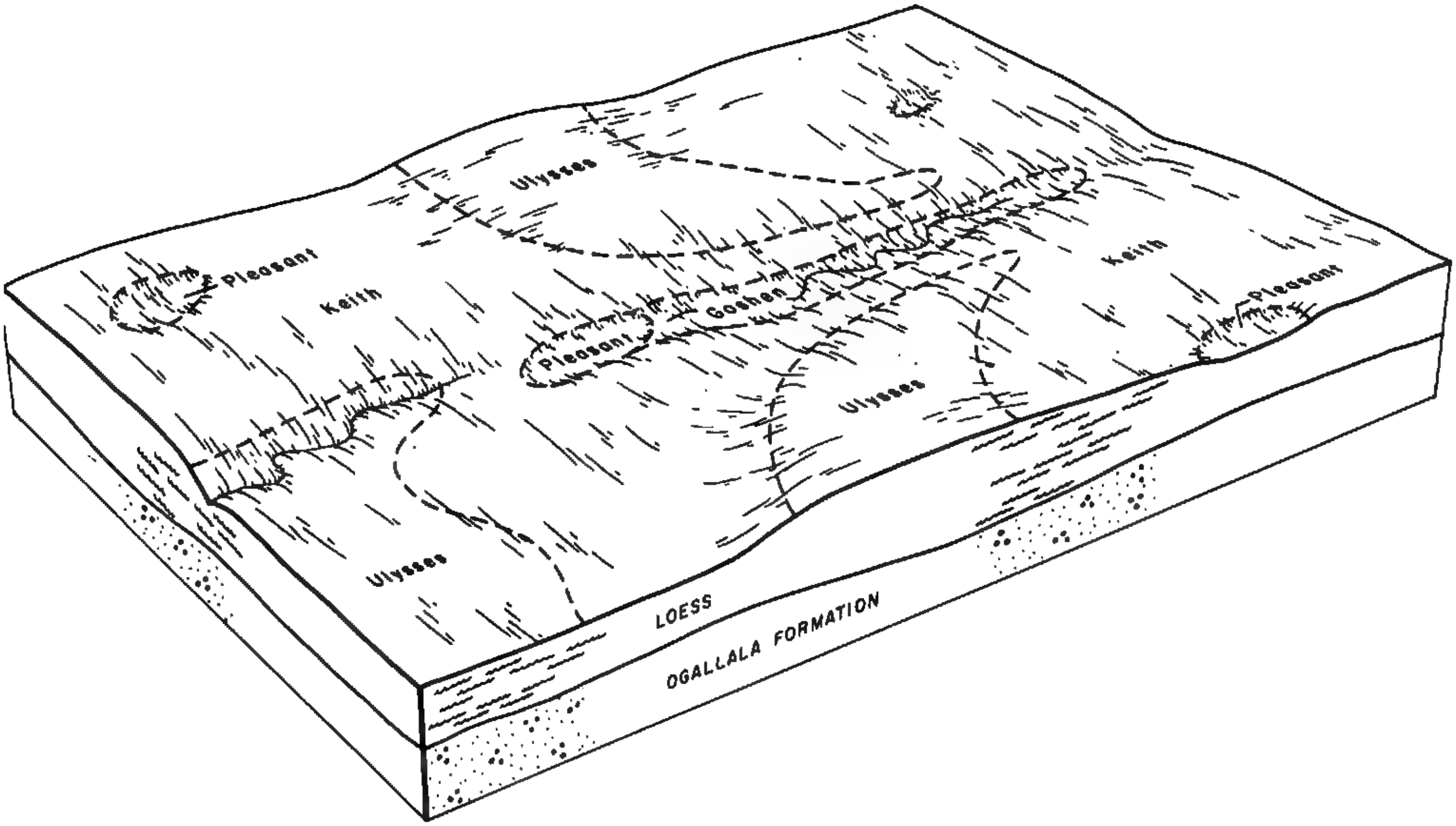

Figure 1.—Typical pattern of soils in the Keith-Ulysses association.

sions, and the Richfield soils on slightly convex slopes. The Richfield soils are more clayey than the major soils.

Most of this association is used for cultivated crops. The major soils are well suited to all the dryland and irrigated crops grown in the county. Wheat and grain sorghum are the main dryland crops. Corn, alfalfa, sorghum, and wheat are grown in irrigated areas. Controlling soil blowing and water erosion, conserving moisture, and maintaining tilth and fertility are concerns of management.

The major soils have good potential for cultivated crops, range, and windbreaks. They have fair to good potential for openland and rangeland wildlife habitat, good potential for sanitary facilities, and fair potential for building site development.

2. Ulysses-Colby association

Moderately sloping and strongly sloping soils that have a silt loam subsoil; on uplands

This association is on the side slopes of uplands that are dissected by drainageways and creeks. It makes up about 18 percent of the county. It is about 54 percent Ulysses soils, 34 percent Colby soils, and 12 percent minor soils (fig. 2).

The deep, well drained Ulysses soils formed in loess on side slopes and ridgetops. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam.

The deep, well drained Colby soils formed in loess on side slopes. Typically, the surface layer is grayish brown, calcareous silt loam about 4 inches thick. The next 4 inches is pale brown, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The minor soils in this association are Bridgeport, Hord, Roxbury, and Schamber soils. The nearly level Bridgeport, Hord, and Roxbury soils are on flood plains and terraces. The moderately sloping to moderately steep, sandy and gravelly Schamber soils are on side slopes.

Most of this association is used as range, but some areas on flood plains and terraces are cultivated. Proper stocking rates, uniform distribution of grazing, and deferred grazing help to keep the native grasses in good condition. Wheat and sorghum are the main crops in the cultivated areas. Alfalfa is also grown on some of the bottom lands where the supply of moisture is adequate. Controlling erosion and soil blowing, maintaining tilth and fertility, and conserving moisture are concerns of management.

The major soils have good potential for range and windbreaks. They have fair to good potential for cultivated crops and for openland and rangeland wildlife habitat and fair potential for building site development and sanitary facilities.

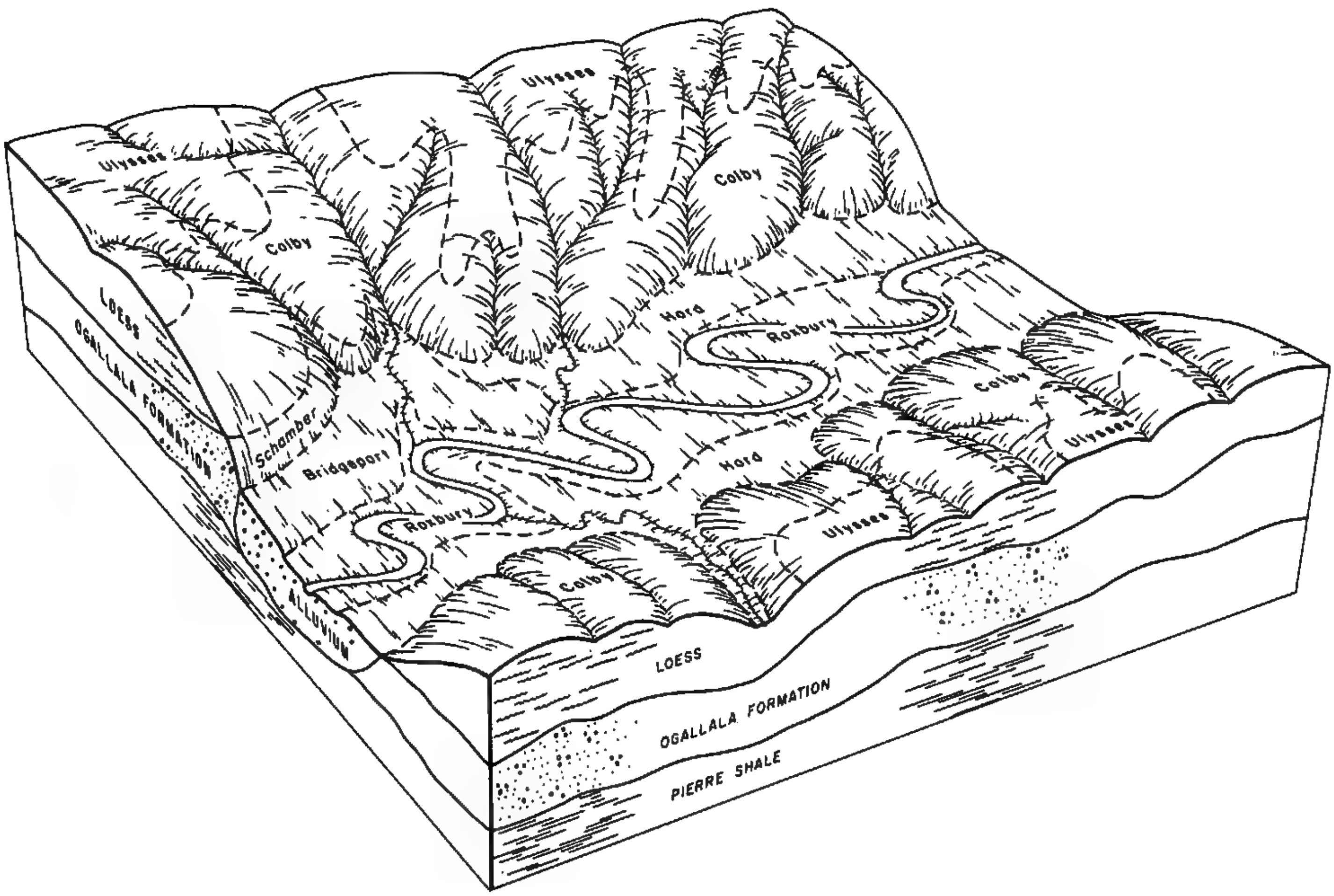

Figure 2.—Typical pattern of soils in the Ulysses-Colby association.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Ulysses silt loam, 3 to 7 percent slopes, is one of several phases in the Ulysses series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil descriptions

Bp—Bridgeport silt loam. This nearly level, well drained soil is on low stream terraces. It is rarely flooded. Individual areas are narrow and long and range from 5 to 60 acres in size.

Typically, the surface soil is dark grayish brown silt loam about 12 inches thick (fig. 3). The subsoil is pale brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In places the surface soil is less than 7 inches thick. In some areas the depth to carbonates is more than 15 inches.

Permeability is moderate, and surface runoff is slow. Reaction is mildly alkaline or moderately alkaline throughout the profile. Available water capacity is high. Natural fertility is also high. The surface soil is friable and can be easily tilled.

Most areas are cultivated. This soil has good potential for cultivated crops, range, windbreaks, and openland wildlife habitat. It has poor potential for building site development and fair potential for sanitary facilities.

This soil is well suited to dryland crops. Wheat and grain sorghum are the main dryland crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control soil blowing.

This soil is suited to irrigated crops, but some areas are too small or too narrow for irrigation. Corn is the main irrigated crop. Alfalfa and sorghum are also grown. A few areas are pastured. The management concerns are efficient use of irrigation water and maintenance of organic matter content, soil fertility, and tilth. Land leveling and water management improve water distribution.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

The flooding is a severe limitation if this soil is used as a site for dwellings and sewage lagoons and a moderate limitation if the soil is used as a septic tank absorption field. Overcoming the flooding is difficult without major flood-control measures. Low strength is a severe limita-

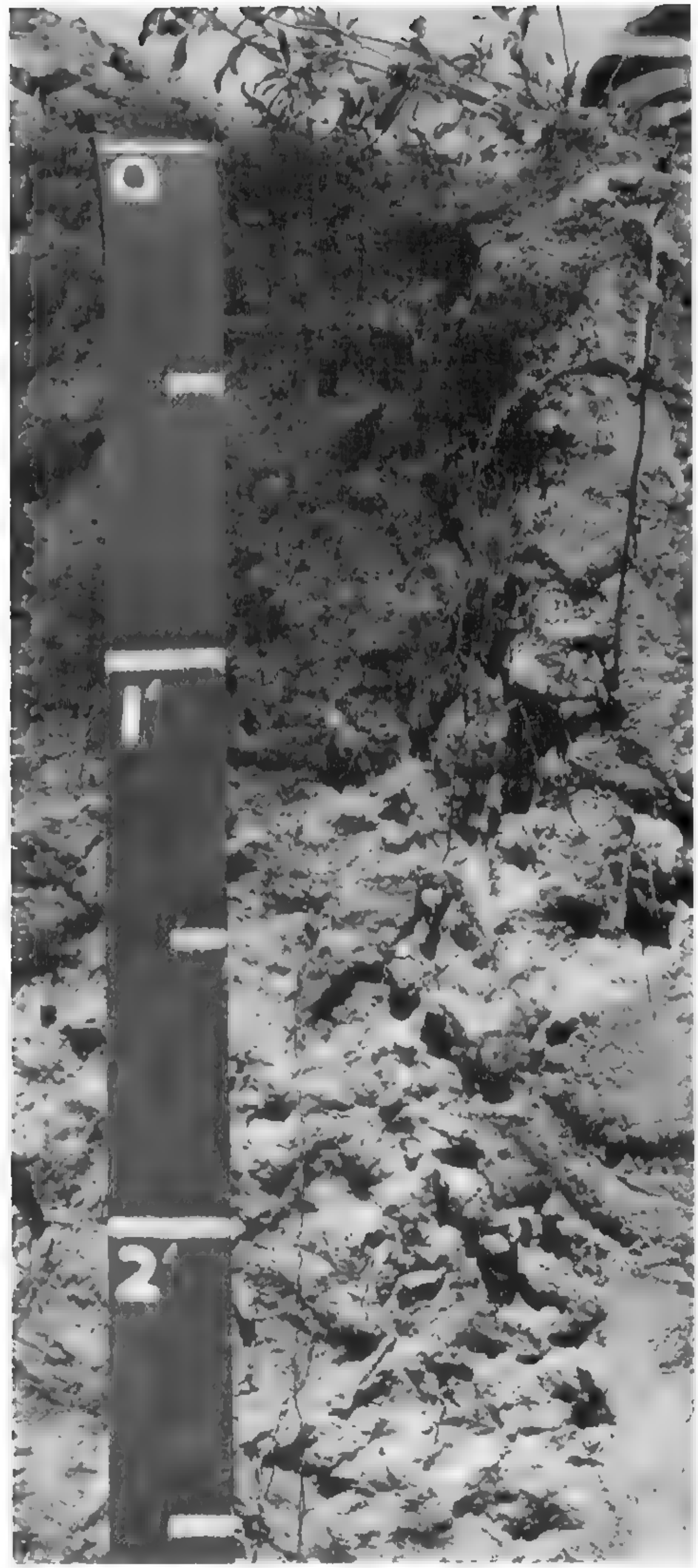

Figure 3.—Profile of Bridgeport silt loam. This soil has a dark colored surface layer and a light colored, calcareous subsoil and substratum.

tion on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIc, dryland, and capability class I, irrigated.

Cd—Colby silt loam, 7 to 15 percent slopes. This strongly sloping, well drained soil is on the sides of the more deeply entrenched drainageways. Individual areas are long and narrow and range from 10 to 300 acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 4 inches thick (fig. 4). The next 4 inches is pale brown, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In places the surface layer is more than 4 inches thick and is dark grayish brown.

Included with this soil in mapping are small areas of Roxbury and Schamber soils. The occasionally flooded Roxbury soils are along drainageways. The gravelly Schamber soils are on side slopes. Included soils make up 2 to 5 percent of the unit.

Permeability is moderate in the Colby soil, and surface runoff is rapid. Available water capacity is high. The surface layer is mildly alkaline or moderately alkaline.

Most areas are used as range. This soil has good potential for range and windbreaks. It has fair potential for openland wildlife habitat and poor potential for cultivated crops. It has fair potential for building site development and sanitary facilities.

This soil is generally unsuited to cultivation because of the severe erosion hazard. It is best suited to range. The major concerns in managing range are related to the hazard of erosion. Overgrazing reduces the growth and vigor of the grasses and increases the runoff rate. Maintaining an adequate plant cover reduces the runoff rate and helps to prevent excessive soil losses. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

The slope is a moderate limitation if this soil is used as a site for dwellings and septic tank absorption fields. Properly designing the dwellings and absorption fields helps to overcome this limitation. The slope is a severe limitation on sites for sewage lagoons. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass VIe, dryland.

Go—Goshen silt loam. This nearly level, well drained soil is on flood plains along upland drainageways. It is occasionally flooded. Individual areas are long and narrow and range from 5 to 100 acres in size.

Typically, the surface soil is dark grayish brown silt loam about 19 inches thick. The subsoil is about 33 inches thick. The upper part is dark grayish brown, firm

Figure 4.—Profile of Colby silt loam, 7 to 15 percent slopes. This soil has a thin surface layer and a calcareous, light colored substratum.

silt loam; the middle part is grayish brown, firm silty clay loam; and the lower part is light brownish gray, friable silt loam. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In places the depth to a light brownish gray layer is less than 20 inches. In some areas the depth to carbonates is less than 32 inches.

Permeability is moderate, and surface runoff is slow. Available water capacity is high. Natural fertility is also high. The surface layer is neutral or mildly alkaline. The surface soil is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are cultivated. This soil has good potential for cultivated crops, range, windbreaks, and openland and rangeland wildlife habitat. It has poor potential for building site development and sanitary facilities.

This soil is well suited to dryland and irrigated crops. Wheat and grain sorghum are the main dryland crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control soil blowing.

In irrigated areas corn is the main crop. Alfalfa, sorghum, sugar beets, and wheat are also grown. A few areas are pastured. The management concerns are efficient use of irrigation water and maintenance of organic matter content, soil fertility, and tilth. Land leveling and water management improve water distribution.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

This soil is generally unsuitable as a site for dwellings and septic tank absorption fields because the flooding is a severe hazard. Overcoming this hazard is difficult without major flood-control measures. Seepage is a moderate limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon. Flooding and low strength are severe limitations on sites for local roads and streets. Constructing roads on suitable fill material and providing adequate culverts help to prevent flood damage. Strengthening or replacing the base material helps to overcome the low strength.

This soil is assigned to capability subclass IIc, dryland, and capability class I, irrigated.

Ha—Hord silt loam. This nearly level, well drained soil is on high stream terraces. Individual areas are irregular in shape and range from about 5 to 75 acres in size.

Typically, the surface soil is dark grayish brown silt loam about 13 inches thick. The subsoil is about 37 inches thick. The upper part is grayish brown, friable silt loam, and the lower part is light brownish gray, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is light brownish gray, calcareous silt loam. In places, the depth to carbonates is less than 30 inches and the depth to a light brownish gray layer less than 20 inches.

Permeability is moderate, and surface runoff is slow. Available water capacity is high. Natural fertility is also high. The surface soil is neutral. It is friable and can be easily tilled.

Most areas are cultivated. This soil has good potential for cultivated crops, range, windbreaks, and openland and rangeland wildlife habitat. It also has good potential for building site development and sanitary facilities.

This soil is well suited to dryland and irrigated crops. Wheat and grain sorghum are the main dryland crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control soil blowing.

In irrigated areas corn is the main crop. Alfalfa, sorghum, sugar beets, and wheat are also grown. A few areas are pastured. The management concerns are efficient use of irrigation water and maintenance of organic matter content, soil fertility, and tilth. Land leveling and water management improve water distribution.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

This soil is suitable as a site for dwellings and septic tank absorption fields. Seepage is a moderate limitation, however, on sites for sewage lagoons. Sealing the lagoon helps to overcome this limitation. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIc, dryland, and capability class I, irrigated.

Ka—Keith silt loam, 0 to 1 percent slopes. This nearly level, well drained soil is on smooth broad uplands. Individual areas range from 20 to several hundred acres in size.

Typically, the surface soil is dark grayish brown silt loam about 11 inches thick. The subsoil is about 20 inches thick. The upper part is grayish brown, friable silty clay loam, and the lower part is light brownish gray, friable, calcareous silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In some places the soil is dark grayish brown to a depth of 20 to 30 inches. In other places it has a dark buried horizon in the lower part. In some areas the depth to carbonates is less than 14 inches. In places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the moderately well drained Pleasant soils. These soils occupy shallow depressions. They make up less than 1 percent of the unit.

Permeability is moderate in the Keith soil, and surface runoff is slow. Available water capacity is high. Natural fertility is also high. The surface layer is neutral or mildly alkaline. The surface soil is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are cultivated. This soil has good potential for cultivated crops, range, windbreaks, and openland and rangeland wildlife habitat. It has fair potential for building site development and good potential for sanitary facilities.

This soil is well suited to dryland and irrigated crops. Wheat and grain sorghum are the main dryland crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control soil blowing.

This soil is irrigated more than any other soil in the county. Corn is the main irrigated crop (fig. 5). Alfalfa, sorghum, sugar beets, and wheat are also grown. A few areas are pastured. The management concerns are efficient use of irrigation water (fig. 6) and maintenance of organic matter content, soil fertility, and tilth. Land leveling and water management improve water distribution.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

The shrink-swell potential is a moderate limitation if this soil is used as a site for dwellings. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. The

Figure 5.—An irrigated field of corn on Keith silt loam, 0 to 1 percent slopes.

Figure 6.—Tailwater recovery pit on Keith silt loam, 0 to 1 percent slopes.

soil is suitable as a septic tank absorption field. Seepage is a moderate limitation, however, on sites for sewage lagoons. Sealing the lagoon helps to overcome this limitation. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIc, dryland, and capability class I, irrigated.

Kb—Keith silt loam, 1 to 3 percent slopes. This gently sloping, well drained soil is on convex side slopes. Individual areas are irregular in shape and range from about 15 to several hundred acres in size.

Typically, the surface soil is dark grayish brown silt loam about 12 inches thick. The subsoil is about 21 inches thick. The upper part is grayish brown, friable silty clay loam, and the lower part is light brownish gray, friable, calcareous silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In places the depth to carbonates is less than 14 inches.

Permeability is moderate, and surface runoff is medium. Available water capacity is high. Natural fertility is also high. The surface layer is neutral or mildly alkaline. The surface soil is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are cultivated. This soil has good potential for cultivated crops, range, windbreaks, and openland and rangeland wildlife habitat. It has fair potential for building site development and good potential for sanitary facilities.

This soil is well suited to dryland and irrigated crops. Wheat and sorghum are the main dryland crops. Erosion is the main hazard. Controlling erosion and soil blowing and conserving moisture are concerns of management. Summer fallowing, minimum tillage, stubble mulching, terracing, and contour farming conserve moisture and help to control erosion and soil blowing.

This soil is suited to irrigation if erosion is controlled. Sprinkler irrigation is the main type of irrigation (fig. 7). Corn is the main irrigated crop. Alfalfa, sorghum, and wheat are also grown. A few areas are pastured. The management concerns are control of erosion, efficient use of irrigation water, and maintenance of organic matter content, soil fertility, and tilth. Stubble mulching, terracing, contour farming, land leveling, and water management help to control erosion and improve water distribution.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

The shrink-swell potential is a moderate limitation if this soil is used as a site for dwellings. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. The soil is suitable as a septic tank absorption field. Seepage and slope are moderate limitations, however, on sites for sewage lagoons. The seepage can be controlled by sealing the lagoon. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIe, dryland and irrigated.

Pa—Pits, gravel. This map unit consists of open excavations from which soil material, mostly gravel and sand,

Figure 7.—Pivotal sprinkler irrigation on Keith silt loam, 1 to 3 percent slopes.

Figure 8.—Profile of Pleasant silty clay loam. This soil is dark and has blocky structure in the upper part of the subsoil.

has been removed. It generally is in areas where gravel is within a depth of 1 to 10 feet. The pits have nearly vertical banks, 10 to 25 feet high. The spoil material generally is gravelly sand.

The plant cover is sparse. Where pits are abandoned, reshaping the side slopes and backfilling with topsoil help to establish vegetation and control erosion. Onsite investigation is needed to determine suitable alternative uses and the management needed for those uses.

This map unit is assigned to capability subclass VIIs.

Pe—Pleasant silty clay loam. This nearly level, moderately well drained soil is in upland depressions that are ponded. Individual areas are irregular in shape and range from about 5 to 100 acres in size.

Typically, the surface layer is dark gray silty clay loam about 4 inches thick. The subsoil is about 46 inches thick. The upper part is dark gray, firm silty clay (fig. 8), and the lower part is dark grayish brown, friable silty clay loam. The substratum to a depth of about 60 inches is pale brown silt loam. In some areas the depth to free carbonates is less than 50 inches. In places the surface layer is silty clay.

Permeability is slow, and surface runoff is ponded. Available water capacity is high. Natural fertility is also high. The surface layer is neutral. It is firm and is difficult to till. The shrink-swell potential is high.

In most areas this soil is cultivated along with the surrounding soils. It has fair potential for cultivated crops, range, windbreaks, and openland and rangeland wildlife habitat. It has poor potential for building site development and sanitary facilities.

This soil is moderately well suited to dryland crops. Wheat and grain sorghum are the main crops. Ponding of surface water and soil blowing are the main hazards. Terracing, contour farming, and stubble mulch tillage of the surrounding soils help to control the ponding on this soil. Minimum tillage and stubble mulching help to control soil blowing.

This soil is poorly suited to irrigation. Only small areas adjacent to other irrigated soils are irrigated. In some areas this soil and the adjacent soils have been leveled. This leveling helps to prevent ponding.

This soil is moderately well suited to range. Ponding of surface water is the main hazard. Reducing the amount of water that runs off of the surrounding soils helps to control the ponding on this soil. Overgrazing reduces the growth and vigor of the grasses. Proper stocking rates and rotation or deferred grazing improve the range condition.

Ponding is a severe limitation if this soil is used as a site for dwellings, septic tank absorption fields, and local roads and streets. As a result, the soil generally is unsuitable for those uses. The ponding also is a severe limitation on sites for sewage lagoons. High sides on the lagoon, however, can divert surface water.

This soil is assigned to capability subclass IVw, dryland and irrigated.

Rf—Richfield silty clay loam. This nearly level, well drained soil is on broad, convex ridgetops. Individual areas are irregular in shape and range from about 5 to 50 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark grayish brown, firm silty clay loam, and the lower part is light gray, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In places, the subsoil is less clayey and the surface layer is silt loam.

Included with this soil in mapping are small areas of the less clayey Ulysses soils. These soils occupy convex ridges. They make up 3 to 5 percent of the unit.

Permeability is moderately slow in the Richfield soil, and surface runoff is slow. Available water capacity is high. The surface layer is neutral or mildly alkaline. It is firm and is difficult to till. The shrink-swell potential is high.

Most areas are cultivated. This soil has good potential for cultivated crops, range, and windbreaks. It has fair potential for openland and rangeland wildlife habitat and for building site development and sanitary facilities.

This soil is well suited to dryland and irrigated crops. Wheat and grain sorghum are the main dryland crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control soil blowing.

In irrigated areas corn is the main crop. Alfalfa, sorghum, and wheat are also grown. A few areas are pastured. The management concerns are efficient use of irrigation water and maintenance of organic matter content, soil fertility, and tilth. Land leveling and water management improve water distribution.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

The shrink-swell potential is a moderate limitation if this soil is used as a site for dwellings. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability is a moderate limitation on sites for septic tank absorption fields. Increasing the size of the absorption field improves the functioning of the septic tank system. Seepage is a moderate limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIc, dryland, and capability class I, irrigated.

Rx—Roxbury silt loam. This nearly level, well drained soil is on narrow flood plains along the major streams. It is occasionally flooded. Individual areas are long and narrow and range from about 10 to several hundred acres in size.

Typically, the surface soil is dark grayish brown silt loam about 12 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 20 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In some areas carbonates are at a depth of more than 15 inches. In places the soil is sandier and is light gray within 20 inches of the surface.

Included with this soil in mapping are soils in narrow stream channels and on streambanks. Also included, along the South Fork of Sappa Creek, are areas where the seasonal high water table is at a depth of 2 to 3 feet. Included soils make up less than 2 percent of the unit.

Permeability is moderate in the Roxbury soil, and surface runoff is slow. Available water capacity is high. Natural fertility is also high. The surface layer is mildly alkaline or moderately alkaline. It is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are cultivated. This soil has good potential for cultivated crops, range, windbreaks, and openland wildlife habitat. It has poor potential for building site development and sanitary facilities.

This soil is suited to dryland and irrigated crops. Wheat, grain sorghum, and alfalfa are the main dryland crops. Flooding is the main hazard. Inadequate rainfall is an additional problem. Controlling flooding and soil blowing and conserving moisture are concerns of management. Summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control soil blowing.

This soil is suited to irrigation. Because the areas are long and narrow, however, only a few are irrigated. Corn is the main irrigated crop. Alfalfa, sorghum, and wheat are also grown. The management concerns are control of flooding, efficient use of irrigation water, and maintenance of organic matter content, soil fertility, and tilth.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

Flooding is a severe hazard if this soil is used as a site for dwellings, local roads and streets, septic tank absorption fields, or sewage lagoons. As a result, the soil is generally unsuitable for those uses. Overcoming the flooding is difficult without major flood-control measures.

This soil is assigned to capability subclass IIw, dryland and irrigated.

Sc—Schamber gravelly sandy loam, 5 to 25 percent slopes. This moderately sloping to moderately

steep, excessively drained soil is on convex side slopes. Individual areas are long and narrow and range from about 5 to 70 acres in size.

Typically, the surface layer is dark brown gravelly sandy loam about 4 inches thick. The substratum to a depth of about 60 inches is light yellowish brown. The upper part is gravelly loamy sand, and the lower part is gravelly sand. In some areas the surface layer is more than 7 inches thick. In other areas it is gravelly loamy sand or loamy sand.

Included with this soil in mapping are small areas of loamy soils along drainageways and small areas of Colby soils on the upper side slopes and on ridgetops. Also included are small areas of rock outcrop. Included areas make up 5 to 15 percent of the unit.

Permeability is rapid in the Schamber soil. Surface runoff is also rapid. Available water capacity is low. Natural fertility is also low. The surface layer is mildly alkaline.

Most areas are used for range. This soil has fair potential for range. It has poor potential for cultivated crops, windbreaks, rangeland wildlife habitat, building site development, and sanitary facilities. It is a good source for sand and gravel.

This soil is best suited to range. The major concerns in managing range are the low available water capacity and the hazard of erosion. Overgrazing reduces the growth and vigor of the grasses and increases the runoff rate. Maintaining an adequate plant cover reduces the runoff rate and helps to prevent excessive soil losses. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

The slope is a severe limitation if this soil is used as a site for dwellings, septic tank absorption fields, and local roads and streets. The less sloping areas are the better sites. The soil is generally unsuitable as a site for sewage lagoons because slope and seepage are severe limitations.

This soil is assigned to capability subclass VIs.

Ua—Ulysses silt loam, 0 to 1 percent slopes. This nearly level, well drained soil is on smooth broad uplands. Individual areas are irregular in shape and range from 15 to 600 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick (fig. 9). The subsoil is friable silt loam about 12 inches thick. The upper part is dark grayish brown, and the lower part is pale brown and calcareous. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In places, the subsoil is thicker and more clayey and free carbonates are below a depth of 15 inches.

Included with this soil in mapping are Richfield soils on convex ridges. These soils have a more clayey subsoil than the Ulysses soil. They make up less than 2 percent of the unit.

Permeability is moderate in the Ulysses soil, and surface runoff is slow. Available water capacity is high. Natural fertility is also high. The surface layer is neutral or mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is moderate.

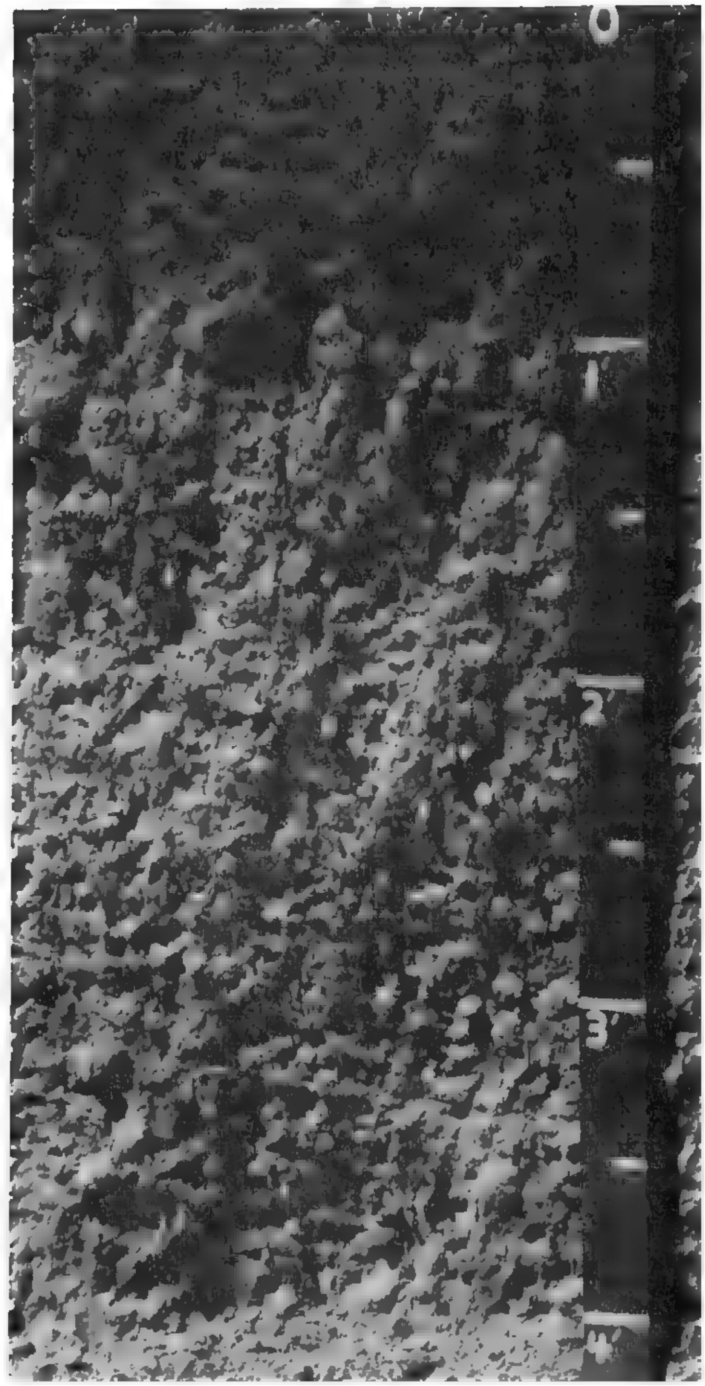

Figure 9.—Profile of Ulysses silt loam, 0 to 1 percent slopes. This soil is dark colored in the upper part and light colored and calcareous in the lower part.

Most areas are cultivated. This soil has good potential for cultivated crops, range, and windbreaks. It has fair

potential for openland and rangeland wildlife habitat. It has good potential for building site development and sanitary facilities.

This soil is well suited to dryland and irrigated crops. Wheat and grain sorghum are the main dryland crops. Inadequate rainfall is the main limitation. Conserving moisture and controlling soil blowing are concerns of management. Summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control soil blowing.

In irrigated areas corn is the main crop. Alfalfa, sorghum, sugar beets, and wheat are also grown. A few areas are pastured. The management concerns are efficient use of irrigation water and maintenance of organic matter content, soil fertility, and tilth. Land leveling and water management improve water distribution.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

This soil is suitable as a site for dwellings with basements and as a septic tank absorption field. Seepage is a moderate limitation, however, on sites for sewage lagoons. Sealing the lagoon helps to overcome this limitation. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIc, dryland, and capability class I, irrigated.

Ub—Ulysses silt loam, 1 to 3 percent slopes. This gently sloping, well drained soil is on convex side slopes. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is friable silt loam about 10 inches thick. The upper part is dark grayish brown, and the lower part is pale brown and calcareous. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In places the surface layer is lighter colored. In some areas, the subsoil is thicker and more clayey and carbonates are below a depth of 15 inches.

Included with this soil in mapping are Richfield soils on the upper side slopes. These soils have a more clayey subsoil than the Ulysses soil. They make up less than 2 percent of the unit.

Permeability is moderate in the Ulysses soil, and surface runoff is medium. Available water capacity is high. Natural fertility is also high. The surface layer is neutral or mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are cultivated. This soil has good potential for cultivated crops, range, and windbreaks. It has fair potential for openland and rangeland wildlife habitat. It has good potential for building site development and sanitary facilities.

This soil is well suited to dryland and irrigated crops. Wheat and grain sorghum are the main dryland crops. Erosion is the main hazard. Inadequate rainfall is an additional problem. Conserving moisture and controlling erosion and soil blowing are concerns of management. Terracing, contour farming, summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control erosion and soil blowing.

This soil is suited to irrigation if erosion is controlled. Corn is the main irrigated crop. Alfalfa, sorghum, and wheat are also grown. A few areas are pastured. The management concerns are control of erosion, efficient use of irrigation water, and maintenance of organic matter content, soil fertility, and tilth. Sprinklers can be used if the soil is terraced. A gravity irrigation system can be used if the land is leveled or irrigated on the contour.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

This soil is suitable as a site for dwellings with basements and as a septic tank absorption field. Seepage and slope are moderate limitations, however, on sites for sewage lagoons. Sealing the lagoon helps to control the seepage. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIe, dryland and irrigated.

Ue—Ulysses silt loam, 1 to 3 percent slopes, eroded. This gently sloping, well drained soil is on convex ridges and side slopes. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 7 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 6 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In places the surface layer is lighter colored.

Permeability is moderate, and surface runoff is medium. Available water capacity is high. The surface layer is mildly alkaline. It is friable and can be easily tilled. Natural fertility is medium. The shrink-swell potential is moderate.

Most areas are cultivated. This soil has good potential for cultivated crops, range, and windbreaks and fair potential for openland and rangeland wildlife habitat. It has good potential for building site development and sanitary facilities.

This soil is suited to dryland and irrigated crops. Wheat is the main dryland crop. Grain sorghum is also grown. It is susceptible to chlorosis because of the high content of carbonates. Erosion is the main hazard. Inadequate rainfall is an additional problem. Conserving moisture and controlling erosion and soil blowing are concerns of

management. Terracing, contour farming, summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control erosion and soil blowing.

This soil is suited to irrigation if erosion is controlled. Corn is the main irrigated crop. Alfalfa and wheat are also grown. A few areas are pastured. The management concerns are control of erosion, efficient use of irrigation water, and maintenance of organic matter content, soil fertility, and tilth. Sprinklers can be used if the soil is terraced. A gravity irrigation system can be used if the land is leveled or irrigated on the contour.

This soil is suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

This soil is suitable as a site for dwellings with basements and as a septic tank absorption field. Seepage and slope are moderate limitations, however, on sites for sewage lagoons. Sealing the lagoon helps to control the seepage. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIIe, dryland, and IIe, irrigated.

Us—Ulysses silt loam, 3 to 7 percent slopes. This moderately sloping, well drained soil is on side slopes along drainageways. Individual areas are long and narrow and range from about 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 7 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In places the surface layer is lighter colored and is less than 7 inches thick.

Included with this soil in mapping are small areas of the occasionally flooded Roxbury soils on flood plains. These soils make up about 1 to 3 percent of the unit.

Permeability is moderate in the Ulysses soil, and surface runoff is medium. Available water capacity is high. Natural fertility is also high. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is moderate.

About two-thirds of the acreage is cultivated. The rest is mostly range. This soil has good potential for cultivated crops, range, and windbreaks and fair potential for openland and rangeland wildlife habitat. It has good potential for building site development and sanitary facilities.

This soil is well suited to dryland crops but is poorly suited to irrigated crops. Wheat and grain sorghum are the main dryland crops. Grain sorghum is susceptible to chlorosis because of the high content of carbonates. Erosion is the main hazard. Conserving moisture and controlling erosion and soil blowing are concerns of management. Terracing, contour farming, summer fallowing, minimum tillage, and stubble mulching conserve moisture and help to control erosion and soil blowing.

This soil is well suited to range. Overgrazing, however, reduces the vigor and growth of the taller grasses and allows the shorter, less productive grasses to become established. Proper stocking rates, rotation or deferred grazing, and proper distribution of salt and water improve the range condition.

This soil is suitable as a site for dwellings with basements and as a septic tank absorption field. Seepage and slope are moderate limitations, however, on sites for sewage lagoons. Sealing the lagoon helps to control the seepage. Low strength is a severe limitation on sites for local roads and streets. Strengthening or replacing the base material helps to overcome this limitation.

This soil is assigned to capability subclass IIIe.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, and trees.

Crops and pasture

Earl Bondy, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Approximately 85 percent of the acreage in Thomas County is cropland (*4*). During the period 1966 to 1976, wheat was planted on 44 percent of the cropland, corn on 6 percent, sorghum on 5 percent, and alfalfa and rye on 2 percent. The rest of the cropland was summer fallowed for dryland wheat. Corn is the principal irrigated crop.

Because the extent of irrigation has increased in the period 1966 to 1976, the acreage planted to corn is five times greater than in the period 1956 to 1966. The acreage planted to wheat has increased 10 percent. The acreage planted to barley has decreased 92 percent and the acreage planted to sorghum 61 percent. The acreage planted to alfalfa has more than doubled but is still only 1 percent of the cropped acreage.

Water erosion is the major problem on 40 percent of the cropland in Thomas County. Soil blowing is an additional problem on all cropland.

Erosion-control practices provide protective plant cover, reduce the runoff rate, and increase the infiltration rate. A cropping system that keeps plant cover on the soil for extended periods reduces the risk of erosion and preserves the productive capacity of the soils.

Terraces and diversions reduce the length of slopes and help to control runoff and erosion. They are most practical on the deep, well drained Keith and Ulysses soils that have uniform, regular slopes.

Contour tillage should generally be used in combination with terraces. It is best suited to those soils that have smooth, uniform slopes and can be terraced.

Leaving crop residue on the surface, either by stubble mulching or minimum tillage, increases the infiltration rate and reduces the runoff rate and the hazard of water erosion. The extra cover helps to prevent soil blowing. Crop residue is left on the surface of 80 percent of the cropland in the county.

Information about the design of erosion-control practices is available in county offices of the Soil Conservation Service. The latest information about growing crops can be obtained from the Cooperative Extension Service or the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Rangeland

Loren J. Pearson, range conservationist, Soil Conservation Service, helped prepare this section.

Approximately 15 percent of Thomas County is rangeland. About 15 percent of the farm income is from the sale of livestock. Much of the rangeland is along the major streams, in the more sloping areas.

On many ranches the forage on rangeland is supplemented by sorghum stubble, small grain stubble, and some bromegrass on the bottom land. In winter native forage is supplemented with corn or sorghum forage, alfalfa, and protein concentrates.

Soils strongly influence the potential natural vegetation within the county. The loamy soils are suitable for the short and mid grasses that are common to the area. Also, the amount of rainfall favors this kind of vegetation. Productivity of the grasses can be maintained or increased by applying management that is effective on specific kinds of soil and range sites.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condi-

tion. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. To achieve this objective, about 50 percent of the seasonal growth should remain on the site at the end of a grazing period. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Deferment of grazing during the main part of the growing season of key forage plants improves or maintains the condition of a range site. If deferment is a recurring part of a planned grazing system, the key forage plants can produce seed.

Range seeding may be necessary to convert cropland to rangeland or to improve depleted rangeland. Reseeding suitable species increases forage production in depleted areas.

Windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 10). They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow at the edge of fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

Careful planning and special management are needed on sites for windbreaks. The trees and shrubs should be selected according to their ability to grow on the different kinds of soil. They generally cannot grow well on gravelly soils, such as Schamber soils. Site preparation is needed before the trees or shrubs are planted. Summer fallowing and measures that control grasses and weeds increase the amount of available moisture. In areas where trees are young, protection from fire, livestock, insects, rabbits, and rodents is needed.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of con-

Figure 10.—Farmstead windbreak on Keith silt loam, 1 to 3 percent slopes.

struction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily

overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary facilities

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level

of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 10, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 11 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction

of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Thomas County has a few areas of scenic and historic interest. A few small streams and farm ponds provide opportunities for recreation on privately owned land. Some stock water ponds provide good fishing. The number of public recreation areas is limited. The potential for additional recreational development is fair.

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 12, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 12 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Thomas County are pheasant, mourning dove, cottontail rabbit, and several species of waterfowl. Nongame species are numerous. Many different species can inhabit areas where cropland and grassland are interspersed with trees. Furbearers are sparse in all areas except for those along wooded streams. The fish commonly caught in the county are channel cat, bass, and bluegill.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 13, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and

other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bromegrass and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are wheatgrass, grama, bluestem, cactus, and sunflowers.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are fragrant sumac, smooth sumac, buckbrush, and plum.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, cattail, cordgrass, buttonbush, and indigobush and rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, redwinged blackbirds, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, prairie dog, coyote, jack rabbit, mule deer, meadowlark, hawk, and killdeer.

Technical assistance in planning wildlife areas and in determining suitable species of vegetation for planting can be obtained from the Soil Conservation Service, the Kansas Fish and Game Commission, and the Cooperative Extension Service.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg

limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SW-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are

based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave

and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*3*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*5*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Bridgeport series

The Bridgeport series consists of deep, well drained, moderately permeable soils on low stream terraces. These soils formed in calcareous loamy alluvium. Slopes range from 0 to 2 percent.

Bridgeport soils are similar to Hord, Roxbury, and Ulysses soils and are commonly adjacent to those soils. Hord and Roxbury soils have a mollic epipedon that is thicker than 20 inches. Hord soils are deeper to carbonates than Bridgeport soils. They are on the higher stream terraces. The occasionally flooded Roxbury soils are on flood plains. Ulysses soils are not stratified. Typically, they are steeper than Bridgeport soils and are higher on the landscape.

Typical pedon of Bridgeport silt loam, 2,000 feet south and 100 feet west of the northeast corner of sec. 31, T. 6 S., R. 33 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; common fine roots; few worm casts; mildly alkaline; gradual smooth boundary.

B2—12 to 24 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak fine and medium granular structure; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—24 to 60 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; thin, darker colored strata; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 35 inches. Carbonates are within a depth of 15 inches and commonly are at or near the surface. Reaction is mildly alkaline or moderately alkaline throughout the profile. Thin, lighter or darker strata are at a depth of more than 20 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. The B2 horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3.

Colby series

The Colby series consists of deep, well drained, moderately permeable soil on uplands. These soils formed in calcareous loess. Slopes range from 7 to 15 percent.

Colby soils are similar to Ulysses soils and are commonly adjacent to Keith, Schamber, and Ulysses soils. Ulysses soils have a mollic epipedon. They typically are less sloping than Colby soils and are higher on the landscape. Keith soils also are less sloping. They have a mollic epipedon and an argillic horizon. Schamber soils contain sand and gravel. They typically are steeper than Colby soils.

Typical pedon of Colby silt loam, 7 to 15 percent slopes, 125 feet east and 2,340 feet south of the northwest corner of sec. 11, T. 7 S., R. 34 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine granular structure; soft, very friable; many fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

AC—4 to 8 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate medium and fine

granular structure; soft, very friable; many fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C—8 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; few fine roots; few worm casts; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 3 to 10 inches. The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. In pedons where it has hue of 10YR and value of 5 (3 moist), it is less than 4 inches thick.

The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is mildly alkaline or moderately alkaline. Some pedons have a Cca horizon.

Goshen series

The Goshen series consists of deep, well drained, moderately permeable soils along upland drainageways. These soils formed in colluvial and alluvial sediments derived from adjacent slopes. Slopes range from 0 to 2 percent.

Goshen soils are similar to Hord, Keith, and Roxbury soils and are commonly adjacent to Keith, Pleasant, and Ulysses soils. Roxbury and Hord soils lack an argillic horizon. They are along creeks. Keith and Ulysses soils have a mollic epipedon that is less than 20 inches thick. They are on side slopes and broad ridgetops. Pleasant soils are finer textured throughout than Goshen soils. They are in shallow depressions.

Typical pedon of Goshen silt loam, 2,850 feet east and 1,225 feet north of the southwest corner of sec. 1, T. 8 S., R. 34 W.

A1—0 to 19 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable; many fine roots; few worm casts; mildly alkaline; gradual smooth boundary.

B21t—19 to 30 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; mildly alkaline; gradual smooth boundary.

B22t—30 to 38 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; moderately alkaline; gradual smooth boundary.

B3—38 to 52 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; moderately alkaline; gradual smooth boundary.

C—52 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 32 to 60 inches. The mollic epipedon ranges from 20 to 40 inches in thickness and generally extends into the B horizon.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The upper part of the B horizon has the same colors as the A horizon. The lower part has hue of 10YR, value of 5 or 6 (3 or 4 moist), and chroma of 2 or 3. The B horizon is silt loam or silty clay loam that ranges from 18 to 35 percent clay. It is mildly alkaline or moderately alkaline. The lower part is calcareous in some pedons.

Hord series

The Hord series consists of deep, well drained, moderately permeable soils on high stream terraces. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Hord soils are similar to Bridgeport, Goshen, and Roxbury soils and are commonly adjacent to Bridgeport, Roxbury, and Ulysses soils. Bridgeport, Roxbury, and Ulysses soils have carbonates that are nearer the surface than those in Hord soils. Goshen soils have an argillic horizon. They are along upland drainageways. The occasionally flooded Roxbury soils are on flood plains. Bridgeport and Ulysses soils have a mollic epipedon that is less than 20 inches thick. Bridgeport soils are on low stream terraces. Ulysses soils are steeper than Hord soils and are higher on the landscape.

Typical pedon of Hord silt loam, 2,100 feet west and 75 feet south of the northeast corner of sec. 5, T. 8 S., R. 35 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; few fine roots; neutral; clear smooth boundary.

A12—6 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

B2—13 to 34 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

B3ca—34 to 50 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; few fine roots; strong effervescence; common fine threads of carbonate; mildly alkaline; gradual smooth boundary.

Cca—50 to 60 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; strong effervescence; common fine threads of carbonate; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 30 to 45 inches. The mollic epipedon ranges from 20 to 40 inches in thickness and extends into the B horizon.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The B2 horizon is similar in color to the A horizon. It is silt loam or silty clay loam. The B3ca horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. The C horizon has the same colors as the B3ca horizon.

Keith series

The Keith series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous silty loess. Slopes range from 0 to 3 percent.

Keith soils are similar to Goshen, Richfield, and Ulysses soils and are commonly adjacent to Goshen, Pleasant, Richfield, and Ulysses soils. Goshen and Pleasant soils have a mollic epipedon that is more than 20 inches thick. The occasionally flooded Goshen soils are along upland drainageways. Pleasant soils are in shallow depressions. Ulysses soils are steeper than Keith soils. They lack an argillic horizon and have a thinner solum. Richfield soils have a fine textured argillic horizon. Their position on the landscape is similar to that of Keith soils.

Typical pedon of Keith silt loam, 0 to 1 percent slopes, 100 feet east and 110 feet north of the southwest corner of sec. 18, T. 10 S., R. 32 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

A12—5 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

B2t—11 to 19 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

B3ca—19 to 31 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; soft, friable; few fine roots; strong effervescence; common fine threads and soft, white accumulations of carbonate; moderately alkaline; gradual smooth boundary.

Cca—31 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; common fine threads and soft, white accumulations of carbonate; moderately alkaline.

The thickness of the solum ranges from 16 to 36 inches. The mollic epipedon ranges from 8 to 20 inches in thickness. The depth to carbonates averages about 20 inches but ranges from 14 to 30 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is neutral or mildly alkaline. The B2 horizon has hue of 10YR, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The B3ca horizon has hue of 10YR, value of 5 to 7 (3 to 6 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Pleasant series

The Pleasant series consists of deep, moderately well drained, slowly permeable soils in shallow depressions in the uplands. These depressions are a few inches to several feet below the surrounding soils. Slopes are generally less than 1 percent.

Pleasant soils are adjacent to Goshen, Keith, and Ulysses soils: Goshen soils are less clayey than Pleasant soils. They are along upland drainageways. Keith and Ulysses soils have a mollic epipedon that is less than 20 inches thick. They are well drained and are on convex slopes.

Typical pedon of Pleasant silty clay loam, 2,615 feet east and 25 feet north of the southwest corner of sec. 25, T. 8 S., R. 35 W.

Ap—0 to 4 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; hard, firm; neutral; clear smooth boundary.

B21t—4 to 31 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate medium blocky structure; very hard, firm; mildly alkaline; gradual smooth boundary.

B22t—31 to 50 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine blocky structure; hard, friable; mildly alkaline; gradual smooth boundary.

C—50 to 60 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; soft, friable; strong effervescence; moderately alkaline.

The mollic epipedon ranges from 20 to 50 inches in thickness. The depth to calcareous material ranges from 50 to 60 inches or more.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. The B2t horizon has hue of 10YR, value of 4 to 6 (2 to 6 moist), and chroma of 1 to 4. It is silty clay, silty clay loam, or clay. The C horizon is silt loam or silty clay loam. Some pedons lack a C horizon.

Richfield series

The Richfield series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in calcareous silty loess. Slopes range from 0 to 2 percent.

Richfield soils are similar to Keith soils and are commonly adjacent to Keith, Pleasant, and Ulysses soils. Keith and Ulysses soils are fine-silty. They are lower on the landscape than the Richfield soils. Pleasant soils have a mollic epipedon that is thicker than 20 inches. They are in shallow depressions.

Typical pedon of Richfield silty clay loam, 3,000 feet west and 850 feet south of the northeast corner of sec. 15, T. 8 S., R. 35 W.

Ap—0 to 4 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, firm; few fine roots; neutral; clear smooth boundary.

B2t—4 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; hard, firm; few fine roots; neutral; gradual smooth boundary.

B3ca—12 to 23 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak medium and fine subangular blocky structure; soft, very friable; moderately alkaline; strong effervescence; threads and soft accumulations of carbonate; gradual smooth boundary.

Cca—23 to 60 inches; light gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable; moderately alkaline; strong effervescence; threads and soft accumulations of carbonate.

The thickness of the solum ranges from 16 to 30 inches. The depth to carbonates ranges from 10 to 18 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. It is dominantly silty clay loam, but the range includes silt loam. The B2t horizon has colors similar to those of the A horizon. It is silty clay loam or silty clay that ranges from 35 to 42 percent clay. The C horizon has hue of 10YR, value of 6 to 8 (4 to 6 moist), and chroma of 2 or 3.

Roxbury series

The Roxbury series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous loamy alluvium. Slopes range from 0 to 2 percent.

Roxbury soils are similar to Bridgeport, Hord, and Goshen soils and are commonly adjacent to Bridgeport, Hord, and Ulysses soils. Bridgeport and Ulysses soils have a mollic epipedon that is less than 20 inches thick. Bridgeport soils are on low stream terraces. Ulysses soils typically are steeper than Roxbury soils and are higher on the landscape. Hord soils are leached of free carbonates to a depth of more than 15 inches. They are on high stream terraces. Goshen soils have an argillic horizon. They are along upland drainageways.

Typical pedon of Roxbury silt loam, 1,225 feet east and 350 feet south of the northwest corner of sec. 26, T. 6 S., R. 33 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots and worm casts; mildly alkaline; gradual smooth boundary.

B2—12 to 32 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; darker colored strata; moderate medium granular structure; slightly hard, friable; common fine roots; strong effervescence; few fine threads and soft accumulations of carbonate; moderately alkaline; gradual smooth boundary.

C—32 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; strong effervescence; common fine threads and soft accumulations of carbonate; moderately alkaline.

The thickness of the solum ranges from 20 to 60 inches. Carbonates are within a depth of 15 inches. The mollic epipedon is more than 20 inches thick.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. The B horizon has hue of 10YR, value of 4 to 6 (2 to 4 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. In some pedons it has thin strata that have a higher or lower value and that vary in texture.

Schamber series

The Schamber series consists of deep, excessively drained, rapidly permeable soils on uplands. These soils formed in sandy and gravelly sediments of the Ogallala Formation. Slopes range from 5 to 25 percent.

Schamber soils are commonly adjacent to Colby, Keith, and Ulysses soils. These adjacent soils do not have gravel and sand in the solum. Colby soils are on the upper side slopes. Keith and Ulysses soils are less sloping than Schamber soils and are on side slopes above those soils.

Typical pedon of Schamber gravelly sandy loam, 5 to 25 percent slopes, 1,050 feet east and 2,150 feet north of the southwest corner of sec. 10, T. 6 S., R. 32 W.

A1—0 to 4 inches; dark brown (10YR 4/3) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

C1—4 to 20 inches; light yellowish brown (10YR 6/4) gravelly loamy sand, yellowish brown (10YR 5/4) moist; weak granular structure or massive; soft, very friable; mildly alkaline; gradual smooth boundary.

C2—20 to 60 inches; light yellowish brown (10YR 6/4) gravelly sand; single grained; loose; mildly alkaline.

Coarse gravel is typically throughout the soil and on the surface. The A horizon is 3 to 6 inches thick. It has hue of 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is dominantly gravelly sandy loam, but the range includes gravelly loam. The C horizon has hue of 10YR, value 6 or 7 (5 or 6 moist), and chroma of 2 to 4.

Ulysses series

The Ulysses series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous loess. Slopes range from 0 to 7 percent.

Ulysses soils are similar to Bridgeport, Colby, and Keith soils and are commonly adjacent to Colby, Hord, and Keith soils. Bridgeport soils are stratified. They are on low stream terraces. Colby soils lack a mollic epipedon. They are steeper than Ulysses soils and are lower on the landscape. Hord soils are on stream terraces below Ulysses soils. They have a thicker mollic epipedon. Keith soils have an argillic horizon. They are less sloping than Ulysses soils and are higher on the landscape.

Typical pedon of Ulysses silt loam, 1 to 3 percent slopes, 1,100 feet south and 350 feet east of the northwest corner of sec. 18, T. 8 S., R. 33 W.

A1—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

B2—7 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; mildly alkaline; gradual smooth boundary.

B3—12 to 17 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—17 to 60 inches; light gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; few fine roots; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 7 to 15 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. The solum ranges from 10 to 24 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The B2 horizon has hue of 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. In some pedons strata of varying textures are below a depth of 40 inches.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aridic* identifies the subgroup that is drier than is typical for the great group. An example is Aridic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a

subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Aridic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Formation of the soils

This section relates the factors of soil formation to the soils in the survey area.

The characteristics of a soil at any given place are determined by the interaction of five factors of soil formation—climate, plants and other living organisms, parent material, relief, and time. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The effects of each vary from place to place.

Climate and vegetation act on the parent material and gradually change it to a natural body of soil. Relief modifies the effects of climate and vegetation, mainly through its influence on runoff and temperature. The nature of the parent material also affects the kind of soil that forms. Time is needed for changing the parent material into a soil. Generally, a long period is required for the development of distinct soil horizons. The interactions among the five factors are more complex for some soils than for others.

Parent material

Parent material is the unconsolidated material in which the soil forms. It forms through chemical weathering and through the physical weathering of rocks caused by freezing, thawing, and blowing and by the grinding action of rivers and glaciers. The parent materials of the soils in Thomas County are loess, plains outwash, alluvium, and colluvium.

The loess on the uplands consists of calcareous silt loam deposited by wind. Most of the soils of the county formed in loess. Keith, Ulysses, and Colby are the main soils formed in loess. The loess mantle has been thinned or removed on the side slopes of some of the more deeply entrenched drainageways. In these areas the Ogallala Formation is exposed.

The plains outwash, or Ogallala Formation, consists of sand, gravel, silt, and clay, some of which is partly cemented with lime. This material was deposited by shifting streams that originated in the Rocky Mountains during Pliocene time. The Ogallala Formation is the parent material of Schamber soils.

The alluvium consists mostly of silty sediments and small amounts of clay, sand, and gravel. It was recently deposited by water in stream valleys. Loess deposits on uplands are the main sources of the medium textured alluvium. Bridgeport and Roxbury soils formed in alluvium.

The colluvial material in the county is similar to the alluvial material, but it has moved a shorter distance and is near the base of the slopes. Goshen soils formed in colluvial and alluvial sediments.

Climate

Climate is an active factor of soil formation. It directly influences the formation of a soil by weathering the parent material. It indirectly affects formation through its effect on plants and animals on or in the soil.

The climate of Thomas County is continental. It is characterized by dry or moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. The accumulation of soft lime in the substratum of Keith soils is an indication of this excess moisture. As a result of the wetting and drying, nutrients and even soil particles have been leached from the upper horizons of some soils.

Plant and animal life

Plants and animals are important to soil formation. Plants generally influence the amount of nutrients and organic matter in the soil and the color of the surface layer. Earthworms, cicadas, burrowing animals, and other animals help to keep the soil open and porous. Earthworms in Bridgeport soils have left many worm casts. Bacteria and fungi help to decompose the plants, thus releasing more nutrients for plant food.

The mid and short grasses have had the greatest influence on soil formation in Thomas County. As a result of the grasses, the upper part of a typical soil in the county is dark colored and has a high content of organic matter. The transitional part in many places is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color and high in content of carbonate.

Relief

Relief influences the formation of soils through its effect on drainage, runoff, plant cover, and soil temperature. The soil temperature, for example, is slightly lower on the east- and north-facing slopes than on west- and south-facing slopes. Most important is the effect that relief has had on the movement of water on the surface and into the soil.

On the steeper soils in the uplands, the runoff rate is higher than that in the less steep areas. As a result, erosion is more extensive. Relief has retarded the formation of Schamber soils, which formed in the oldest parent material in the county. Runoff is rapid on these moder-

ately sloping to moderately steep soils, and much of the soil material is removed as soon as the soil forms.

Soils having distinct horizons generally formed in the less sloping areas. Nearly level soils on stream terraces formed in the younger parent materials in the county. The Hord soils formed in these materials. Most of the precipitation received penetrates these soils.

Time

A long time generally is needed for distinct horizons to form in a soil. The differences in the length of time that the parent materials have been in place are commonly reflected in the degree of profile development. Some soils form rapidly; others, slowly.

The soils in Thomas County range from immature to mature. Mature soils, such as Keith soils, have a distinct structure. Soils on flood plains, such as Roxbury soils, are subject to stream overflow. They receive new sediments with each flood. As a result, they are immature. They have a thick, dark colored surface layer, but the soil structure is weak.

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Glossary

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.
Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.
Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.
Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles and dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that

accumulated as consolidated rock disintegrated in place.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, and A3).

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay*

loam, sandy clay, silty clay, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or " very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	39.7	12.4	26.1	71	-17	0.39	0.03	0.65	1	4.5
February---	43.2	16.8	30.0	77	-12	0.59	0.09	0.92	2	4.7
March------	48.1	21.8	35.0	85	-12	0.98	0.16	1.63	3	8.2
April------	63.1	35.5	49.3	89	15	1.00	0.57	1.49	3	1.7
May--------	73.8	46.6	60.2	98	29	2.74	1.14	4.42	5	0.5
June-------	82.9	56.0	69.5	105	39	3.83	2.01	6.29	7	0.0
July-------	90.3	62.1	76.2	106	51	3.40	1.83	4.93	6	0.0
August-----	88.8	60.0	74.4	105	45	2.40	0.78	3.74	4	0.0
September--	77.9	49.9	63.9	99	31	1.98	0.48	3.83	4	0.0
October----	67.9	37.5	52.7	92	20	1.18	0.17	2.25	2	1.1
November---	52.6	24.5	38.6	75	8	0.34	0.06	0.51	1	2.6
December---	42.8	15.8	29.3	75	-13	0.38	0.12	0.50	2	4.7
Year-----	64.3	36.6	50.4	106	-17	19.21	14.34	22.67	40	27.9

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 22	May 4	May 21
2 years in 10 later than--	April 17	April 29	May 16
5 years in 10 later than--	April 8	April 19	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	October 14	October 7	September 24
2 years in 10 earlier than--	October 18	October 12	September 28
5 years in 10 earlier than--	October 28	October 21	October 8

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	179	164	134
8 years in 10	187	171	141
5 years in 10	202	185	155
2 years in 10	216	198	170
1 year in 10	224	205	177

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Bp	Bridgeport silt loam	1,075	0.2
Cd	Colby silt loam, 7 to 15 percent slopes	38,500	5.6
Go	Goshen silt loam	15,900	2.3
Ha	Hord silt loam	2,800	0.4
Ka	Keith silt loam, 0 to 1 percent slopes	298,000	43.5
Kb	Keith silt loam, 1 to 3 percent slopes	145,000	21.2
Pa	Pits, gravel	375	0.1
Pe	Pleasant silty clay loam	4,200	0.6
Rf	Richfield silty clay loam	10,000	1.5
Rx	Roxbury silt loam	8,900	1.3
Sc	Schamber gravelly sandy loam, 5 to 25 percent slopes	1,150	0.2
Ua	Ulysses silt loam, 0 to 1 percent slopes	6,400	0.9
Ub	Ulysses silt loam, 1 to 3 percent slopes	65,200	9.5
Ue	Ulysses silt loam, 1 to 3 percent slopes, eroded	16,000	2.3
Us	Ulysses silt loam, 3 to 7 percent slopes	71,300	10.4
	Total	684,800	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil. Only arable soils are listed]

Soil name and map symbol	Grain sorghum		Corn		Alfalfa hay		Winter wheat		Corn silage	
	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu	Ton	Ton
Bp Bridgeport	45	120	---	130	3.0	6.0	33	---	---	20
Go Goshen	45	120	---	130	---	6.0	35	---	---	20
Ha Hord	50	120	---	130	3.0	6.0	35	---	---	20
Ka Keith	45	120	---	130	---	6.0	33	---	---	20
Kb Keith	40	110	---	120	---	5.5	31	---	---	18
Pe Pleasant	30	---	---	---	---	---	24	---	---	---
Rf Richfield	35	105	---	115	---	5.0	28	---	---	17
Rx Roxbury	45	120	---	130	3.0	6.0	33	---	---	20
Ua Ulysses	40	115	---	120	---	5.5	30	---	---	19
Ub Ulysses	35	105	---	115	---	5.0	28	---	---	17
Ue Ulysses	30	100	---	110	---	4.5	26	---	---	15
Us Ulysses	30	100	---	110	---	4.5	26	---	---	15

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Bp: Bridgeport	Loamy Terrace	Favorable	4,000	Big bluestem	30
		Normal	3,000	Western wheatgrass	15
		Unfavorable	2,000	Switchgrass	10
				Little bluestem	10
				Sideoats grama	10
				Indiangrass	5
				Maximilian sunflower	5
Cd: Colby	Limy Upland	Favorable	2,000	Little bluestem	30
		Normal	1,600	Sideoats grama	15
		Unfavorable	1,000	Blue grama	10
				Western wheatgrass	10
				Tall dropseed	5
				Small soapweed	5
Go: Goshen	Loamy Terrace	Favorable	4,000	Big bluestem	30
		Normal	3,000	Western wheatgrass	15
		Unfavorable	2,000	Sideoats grama	10
				Little bluestem	10
				Switchgrass	10
				Indiangrass	5
Ha: Hord	Loamy Terrace	Favorable	4,000	Big bluestem	30
		Normal	3,000	Little bluestem	10
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
				Western wheatgrass	5
Ka, Kb: Keith	Loamy Upland	Favorable	2,400	Western wheatgrass	25
		Normal	1,850	Blue grama	20
		Unfavorable	1,300	Needleandthread	15
				Little bluestem	10
				Buffalograss	10
				Threadleaf sedge	10
				Big bluestem	5
Pe: Pleasant	Clay Upland	Favorable	2,400	Western wheatgrass	50
		Normal	1,800	Buffalograss	15
		Unfavorable	1,000	Blue grama	10
				Sedge	5
Rf: Richfield	Loamy Upland	Favorable	2,400	Blue grama	20
		Normal	1,800	Big bluestem	15
		Unfavorable	800	Sideoats grama	15
				Western wheatgrass	15
				Buffalograss	10
				Little bluestem	5
Rx: Roxbury	Loamy Terrace	Favorable	4,000	Big bluestem	30
		Normal	3,000	Western wheatgrass	15
		Unfavorable	2,000	Switchgrass	10
				Little bluestem	10
				Sideoats grama	8
				Indiangrass	5
				Maximilian sunflower	5
Sc: Schamber	Gravelly Hills	Favorable	1,400	Sideoats grama	30
		Normal	1,000	Blue grama	25
		Unfavorable	700	Litle bluestem	10
				Small soapweed	10
				Hairy grama	5

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
Ua, Ub, Ue, Us: Ulysses	Loamy Upland	Favorable	2,400	Blue grama	25
		Normal	1,800	Western wheatgrass	15
		Unfavorable	1,000	Sideoats grama	10
				Little bluestem	10
				Buffalograss	10
				Big bluestem	10
				Small soapweed	5

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Bp: Bridgeport	Lilac	American plum, common chokecherry.	Eastern redcedar, Russian-olive, green ash, ponderosa pine, common hackberry.	Honeylocust	Siberian elm.
Cd: Colby	Siberian peashrub, fragrant sumac.	Eastern redcedar, Russian-olive, Rocky Mountain juniper.	Ponderosa pine	Siberian elm	---
Go: Goshen	Lilac	American plum, common chokecherry.	Eastern redcedar, ponderosa pine, Austrian pine, green ash, eastern redcedar, common hackberry.	Honeylocust	Eastern cottonwood, Siberian elm.
Ha: Hord	Lilac, fragrant sumac.	American plum, common chokecherry.	Eastern redcedar, ponderosa pine, green ash, common hackberry.	Honeylocust	Siberian elm, eastern cottonwood.
Ka, Kb: Keith	American plum, fragrant sumac, Siberian peashrub.	Rocky Mountain juniper.	Eastern redcedar, ponderosa pine, green ash, honeylocust.	Siberian elm	---
Pa*. Pits					
Pe: Pleasant	Siberian peashrub, fragrant sumac.	Rocky Mountain juniper, eastern redcedar.	Ponderosa pine, Siberian elm.	---	---
Rf: Richfield	Fragrant sumac, American plum, Siberian peashrub.	Rocky Mountain juniper.	Eastern redcedar, honeylocust, ponderosa pine, green ash.	Siberian elm	---
Rx: Roxbury	Lilac	American plum, common chokecherry.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, common hackberry.	Honeylocust	Siberian elm.
Sc. Schamber					
Ua, Ub, Ue, Us: Ulysses	American plum, Siberian peashrub, fragrant sumac.	Rocky Mountain juniper.	Honeylocust, green ash, eastern redcedar, ponderosa pine.	Siberian elm	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Bp: Bridgeport	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength.
Cd: Colby	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Go: Goshen	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
Ha: Hord	Slight	Slight	Slight	Slight	Severe: low strength.
Ka, Kb: Keith	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Pa*: Pits					
Pe: Pleasant	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.
Rf: Richfield	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Rx: Roxbury	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.
Sc: Schamber	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ua, Ub, Ue: Ulysses	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Us: Ulysses	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Bp: Bridgeport	Moderate: floods.	Severe: floods.	Moderate: floods, too clayey.	Moderate: floods.	Fair: too clayey.
Cd: Colby	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Go: Goshen	Severe: floods.	Moderate: seepage.	Severe: floods.	Severe: floods.	Good.
Ha: Hord	Slight	Moderate: seepage.	Slight	Slight	Good.
Ka: Keith	Slight	Moderate: seepage.	Slight	Slight	Good.
Kb: Keith	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Pa*. Pits					
Pe: Pleasant	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Rf: Richfield	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Rx: Roxbury	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
Sc: Schamber	Severe: slope.	Severe: slope, seepage.	Severe: slope, seepage, too sandy.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
Ua: Ulysses	Slight	Moderate: seepage.	Slight	Slight	Good.
Ub, Ue, Us: Ulysses	Slight	Moderate: seepage, slope.	Slight	Slight	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Bp: Bridgeport	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cd: Colby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Go: Goshen	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ha: Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ka, Kb: Keith	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Pa*. Pits				
Pe: Pleasant	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Rf: Richfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Rx: Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sc: Schamber	Fair: slope.	Probable	Probable	Poor: slope, small stones, area reclaim.
Ua, Ub, Ue, Us: Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Bp----------------- Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Cd----------------- Colby	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Go----------------- Goshen	Moderate: seepage.	Severe: piping.	Deep to water	Floods---------	Erodes easily	Erodes easily.
Ha----------------- Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable------	Favorable------	Favorable.
Ka, Kb------------ Keith	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Pa*. Pits						
Pe----------------- Pleasant	Moderate: seepage.	Severe: hard to pack, ponding.	Percs slowly, ponding.	Percs slowly, ponding.	Percs slowly, ponding.	Percs slowly.
Rf----------------- Richfield	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Rx----------------- Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Floods---------	Erodes easily	Erodes easily.
Sc----------------- Schamber	Severe: slope, seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, too sandy.	Slope, droughty.
Ua, Ub, Ue-------- Ulysses	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Us----------------- Ulysses	Moderate: seepage, slope	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Bp: Bridgeport	Severe: floods.	Slight	Slight	Slight.
Cd: Colby	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Go: Goshen	Severe: floods.	Slight	Moderate: floods.	Slight.
Ha: Hord	Slight	Slight	Slight	Slight.
Ka: Keith	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Kb: Keith	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Pa*. Pits				
Pe: Pleasant	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rf: Richfield	Slight	Slight	Slight	Slight.
Rx: Roxbury	Severe: floods.	Slight	Moderate: floods.	Slight.
Sc: Schamber	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: small stones, slope.
Ua: Ulysses	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Ub, Ue, Us: Ulysses	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Bp-----------------Bridgeport	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Cd-----------------Colby	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Very poor	Poor.
Go-----------------Goshen	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
Ha-----------------Hord	Good	Good	Good	Good	Very poor.	Very poor.	Good	Very poor	Good.
Ka, Kb-------------Keith	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Very poor	Good.
Pa*. Pits									
Pe-----------------Pleasant	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Very poor	Fair.
Rf-----------------Richfield	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Very poor	Fair.
Rx-----------------Roxbury	Good	Good	Good	Fair	Poor	Fair	Good	Poor	Fair.
Sc-----------------Schamber	Very poor	Very poor.	Poor	---	Very poor.	Very poor.	Very poor	Very poor	Poor.
Ua, Ub, Ue---------Ulysses	Good	Good	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
Us-----------------Ulysses	Fair	Good	Fair	Poor	Poor	Poor	Fair	Poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Bp---------------- Bridgeport	0-12	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	75-100	25-40	8-20
	12-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	95-100	85-100	25-40	8-20
Cd---------------- Colby	0-4	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	4-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Go---------------- Goshen	0-30	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	90-100	90-100	70-95	20-40	3-20
	30-38	Silty clay loam, loam, silt loam.	ML, CL, CL-ML	A-6, A-4	0	100	100	85-100	60-95	20-40	3-20
	38-60	Silt loam, loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-95	20-35	3-15
Ha---------------- Hord	0-13	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	100	90-100	20-35	3-18
	13-50	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	90-100	25-40	8-23
	50-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	90-100	25-40	6-21
Ka, Kb----------- Keith	0-11	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	95-100	85-95	20-35	2-10
	11-31	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20
	31-60	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-95	20-35	2-12
Pa*. Pits											
Pe---------------- Pleasant	0-4	Silty clay loam	CL	A-6, A-7	0	95-100	90-100	70-95	50-85	35-50	15-25
	4-50	Silty clay loam, silty clay, clay.	CH, CL	A-7	0	95-100	95-100	90-100	80-100	40-65	25-45
	50-60	Silt loam, loam, gravelly loam.	ML, SM	A-4	0-5	80-100	50-100	45-90	40-75	25-40	NP-10
Rf---------------- Richfield	0-4	Silty clay loam	CL	A-6	0	100	100	90-100	75-100	30-40	10-20
	4-12	Silty clay loam, silty clay.	CL, CH	A-7-6	0	100	100	95-100	90-100	40-60	20-35
	12-60	Silty clay loam, silt loam.	CL-ML, CL	A-4, A-6, A-7-6	0	100	100	95-100	85-100	25-45	5-20
Rx---------------- Roxbury	0-12	Silt loam--------	CL	A-4, A-6, A-7-6	0	100	100	96-100	65-98	30-45	8-20
	12-32	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	96-100	80-98	30-50	8-25
	32-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	96-100	65-98	30-50	7-25
Sc---------------- Schamber	0-4	Gravelly sandy loam.	SM, SW-SM, GM, GW-GM	A-2, A-1	0-5	55-90	40-75	30-60	10-35	<25	NP-5
	4-60	Gravelly sand, very gravelly sand, gravelly loamy sand.	SW, SW-SM, GW, GW-GM	A-1	0-15	30-60	15-40	5-20	0-10	<25	NP-5
Ua, Ub, Ue, Us--- Ulysses	0-7	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	7-15
	7-17	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	85-100	25-43	11-20
	17-60	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-35	7-15

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm				
Bp----------------- Bridgeport	0-12	18-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low----------	0.32	5	6
	12-60	18-30	1.35-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low----------	0.43		
Cd----------------- Colby	0-4	15-30	1.20-1.30	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low----------	0.43	5	4L
	4-60	18-27	1.25-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low----------	0.43		
Go----------------- Goshen	0-30	18-35	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low----------	0.32	5	5
	30-38	18-35	1.30-1.50	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate----	0.43		
	38-60	15-27	1.20-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low----------	0.43		
Ha----------------- Hord	0-13	17-27	1.30-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low----------	0.32	5	6
	13-50	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low----------	0.32		
	50-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low----------	0.43		
Ka, Kb------------ Keith	0-11	15-25	1.40-1.60	0.6-2.0	0.22-0.24	6.1-6.5	<2	Low----------	0.32	5	6
	11-31	20-35	1.20-1.40	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate----	0.43		
	31-60	15-25	1.40-1.60	0.6-2.0	0.19-0.21	7.4-8.4	<2	Low----------	0.43		
Pa*. Pits											
Pe----------------- Pleasant	0-4	28-40	---	0.2-0.6	0.17-0.20	6.6-7.3	<2	Low----------	0.24	5	4
	4-50	35-45	---	0.06-0.2	0.14-0.18	6.6-7.8	<2	High---------	0.28		
	50-60	20-27	---	0.2-2.0	0.14-0.18	7.4-8.4	<2	Low----------	0.24		
Rf----------------- Richfield	0-4	27-32	1.35-1.50	0.2-0.6	0.17-0.23	6.6-7.8	<2	Moderate----	0.32	5	7
	4-12	35-42	1.35-1.50	0.2-0.6	0.14-0.19	6.6-8.4	<2	High---------	0.43		
	12-60	18-35	1.20-1.35	0.6-2.0	0.18-0.22	7.9-9.0	<2	Moderate----	0.43		
Rx----------------- Roxbury	0-12	18-35	1.30-1.45	0.6-2.0	0.22-0.24	6.6-8.4	<2	Moderate----	0.32	5	4L
	12-32	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate----	0.43		
	32-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate----	0.43		
Sc----------------- Schamber	0-4	18-25	1.40-1.60	>6.0	0.03-0.06	6.6-8.4	<2	Low----------	0.17	2	6
	4-60	2-10	1.60-1.75	>6.0	0.03-0.06	7.4-8.4	<2	Low----------	0.10		
Ua, Ub, Ue, Us--- Ulysses	0-7	10-27	1.15-1.25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low----------	0.32	5	6
	7-17	21-32	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate----	0.43		
	17-60	18-27	1.25-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low----------	0.43		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Bp: Bridgeport	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Cd: Colby	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Go: Goshen	B	Occasional	Very brief	Mar-Sep	>6.0	---	---	>60	---	Moderate	High	Low.
Ha: Hord	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Ka, Kb: Keith	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Pa*. Pits												
Pe**: Pleasant	C	None	---	---	+1-1.0	Perched	Jun-Jul	>60	---	Low	High	Low.
Rf: Richfield	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Rx: Roxbury	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Sc: Schamber	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Ua, Ub, Ue, Us: Ulysses	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

** In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bridgeport	Fine-silty, mixed, mesic Fluventic Haplustolls
Colby	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Goshen	Fine-silty, mixed, mesic Pachic Argiustolls
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Keith	Fine-silty, mixed, mesic Aridic Argiustolls
Pleasant	Fine, montmorillonitic, mesic Torrertic Argiustolls
Richfield	Fine, montmorillonitic, mesic Aridic Argiustolls
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
Schamber	Sandy-skeletal, mixed, mesic Ustic Torriorthents
Ulysses	Fine-silty, mixed, mesic Aridic Haplustolls

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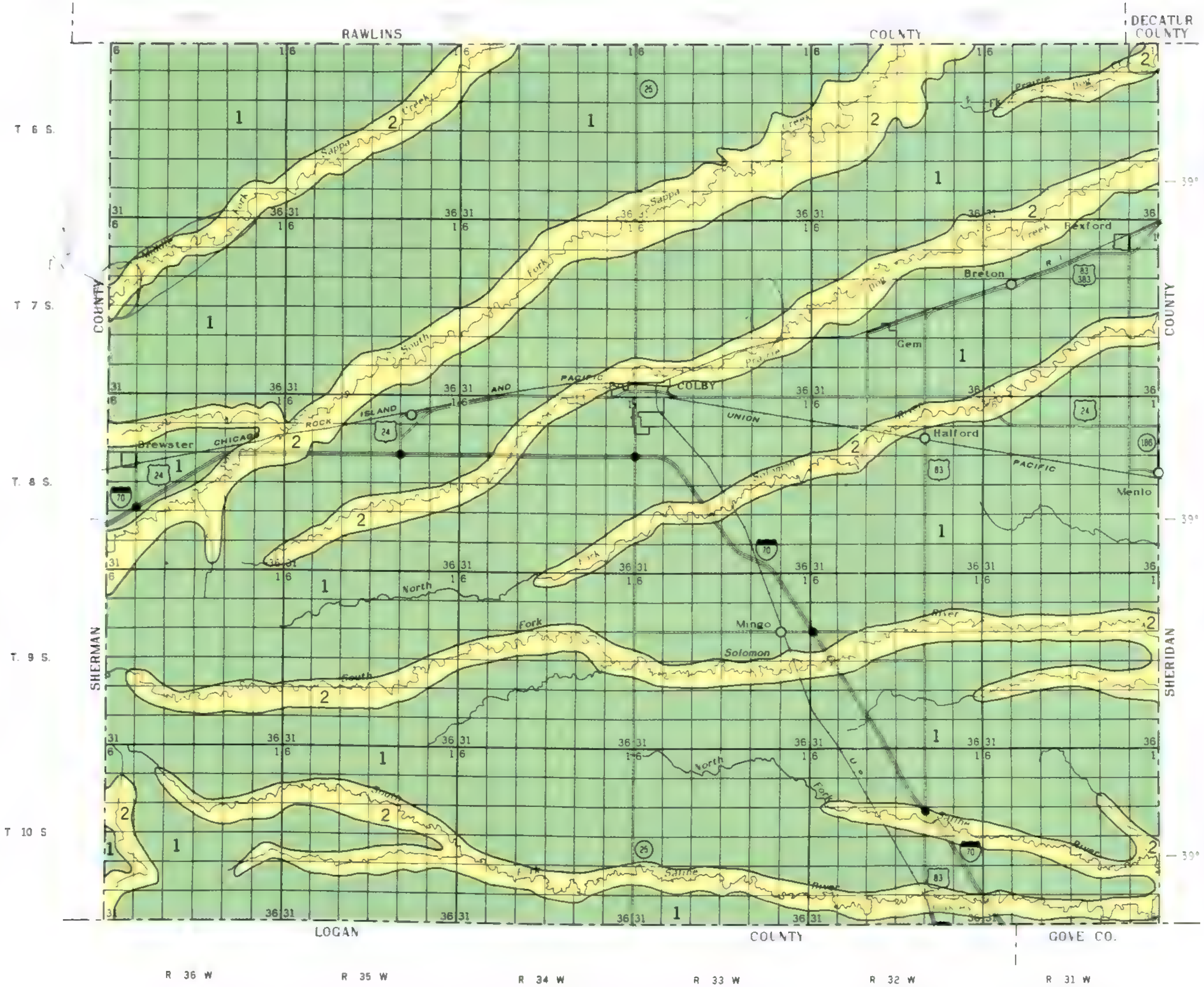
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

THOMAS COUNTY, KANSAS



4 Miles

6 Kilometers

SOIL LEGEND

1	Keith-Ulysses association: Nearly level and gently sloping soils that have a silt loam and silty clay loam subsoil; on uplands
2	Ulysses-Colby association: Moderately sloping and strongly sloping soils that have a silt loam subsoil; on uplands

Compiled 1979

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

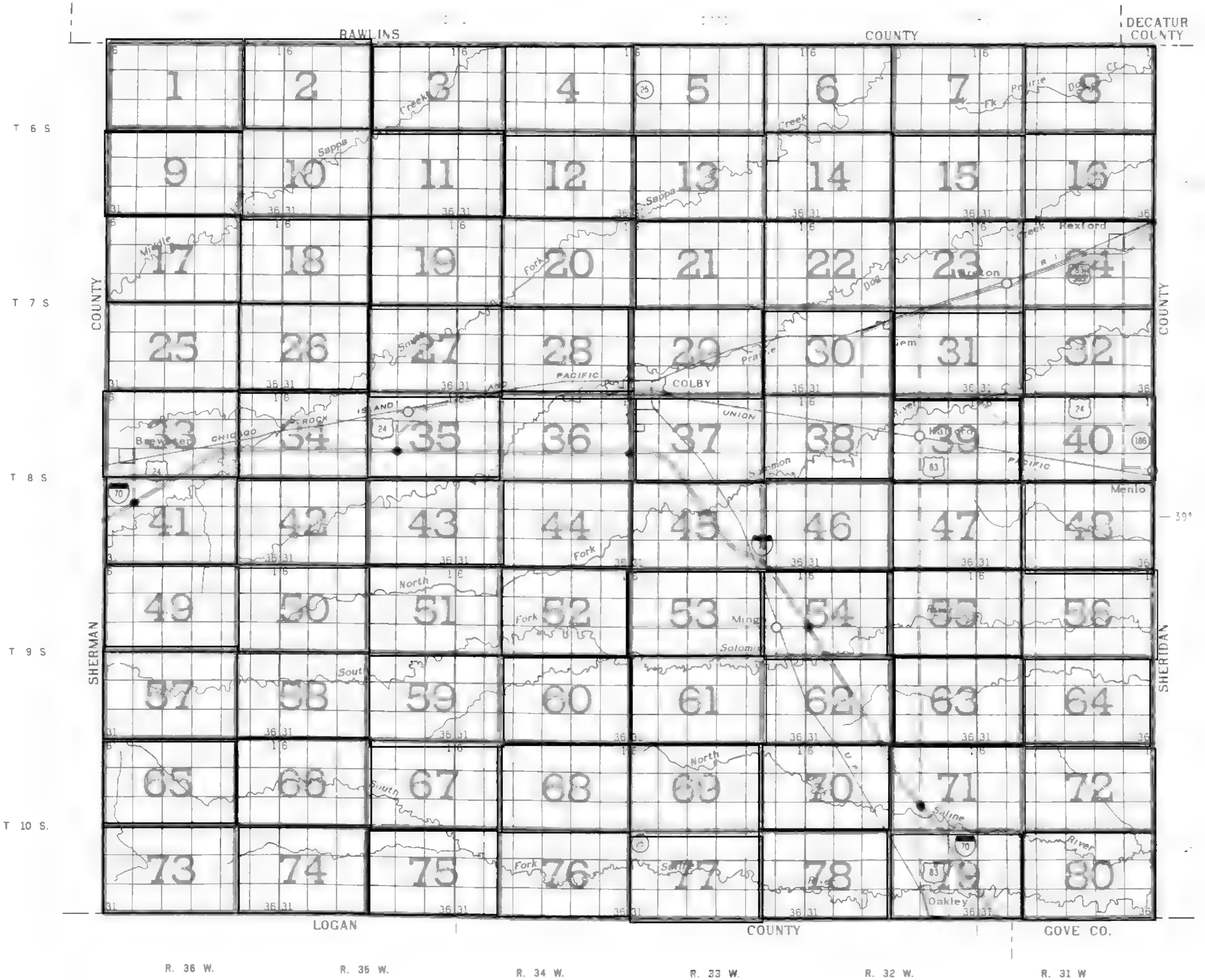
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
THOMAS COUNTY, KANSAS

Scale 1: 253,440

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers



Original text from each individual map sheet read:
This map is compiled on 1977aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — CeA FoB2

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

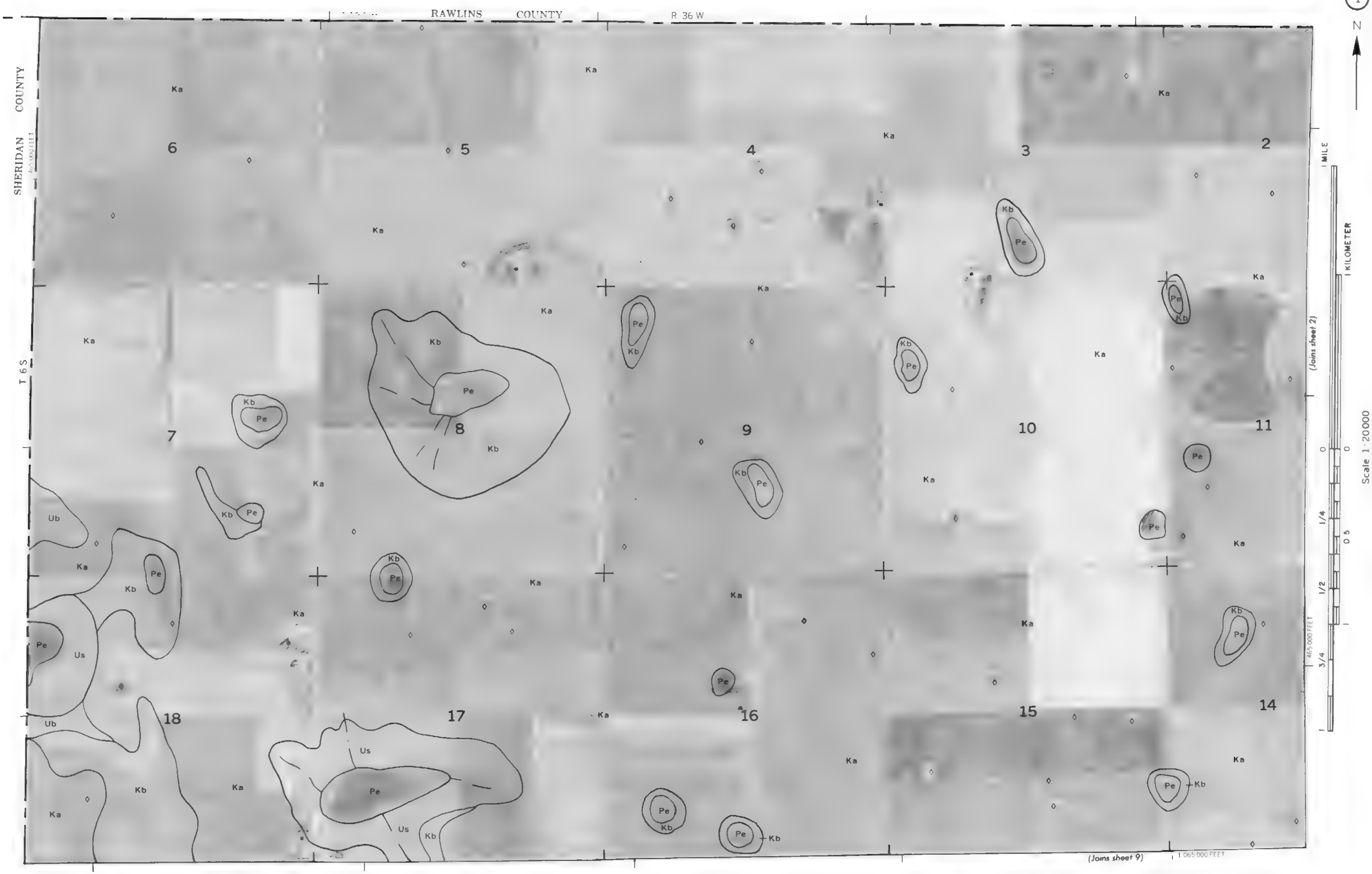
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Limy spot
- Borrow area

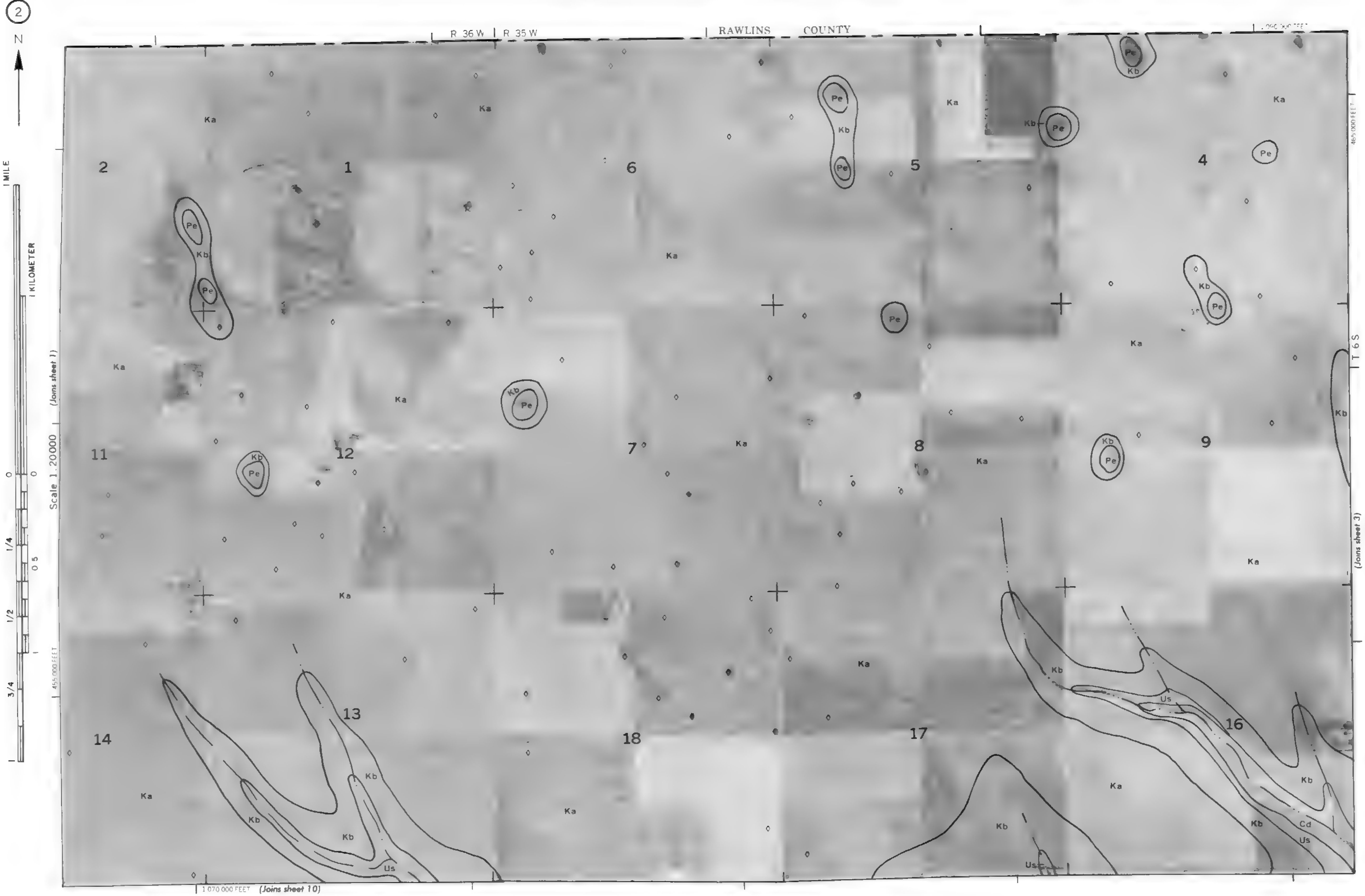
SOIL LEGEND

SYMBOL	NAME
Bp	Bridgeport silt loam
Cd	Colby silt loam, 7 to 15 percent slopes
Go	Goshen silt loam
Ha	Hord silt loam
Ka	Keith silt loam, 0 to 1 percent slopes
Kb	Keith silt loam, 1 to 3 percent slopes
Pa	Pits, gravel
Pe	Pleasant silty clay loam
Rf	Richfield silty clay loam
Rx	Roxbury silt loam
Sc	Schamber gravelly sandy loam, 5 to 25 percent slopes
Ua	Ulysses silt loam, 0 to 1 percent slopes
Ub	Ulysses silt loam, 1 to 3 percent slopes
Ue	Ulysses silt loam, 1 to 3 percent slopes, eroded
Js	Ulysses silt loam, 3 to 7 percent slopes

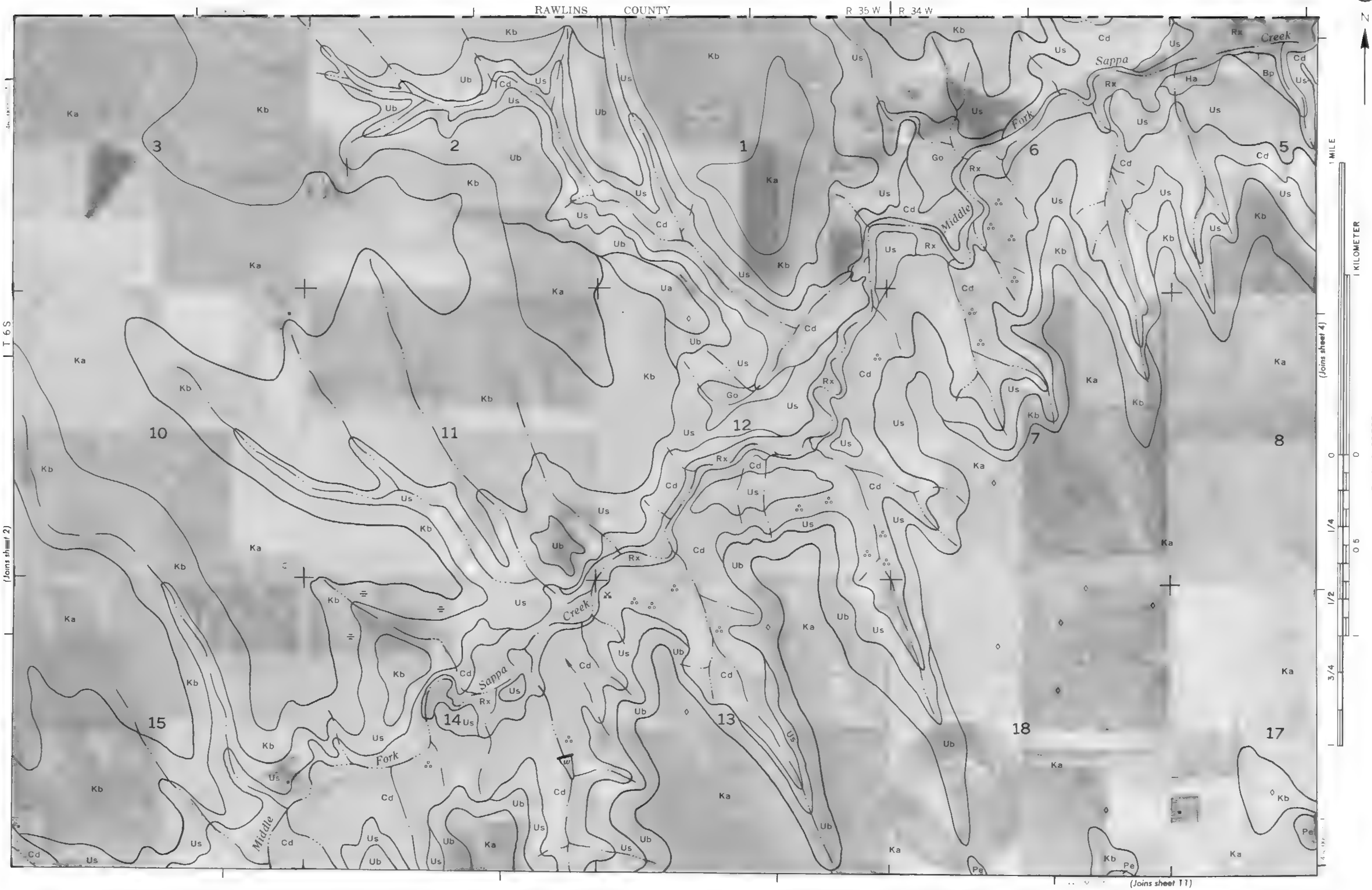
THOMAS COUNTY, KANSAS — SHEET NUMBER 1



THOMAS COUNTY, KANSAS — SHEET NUMBER 2



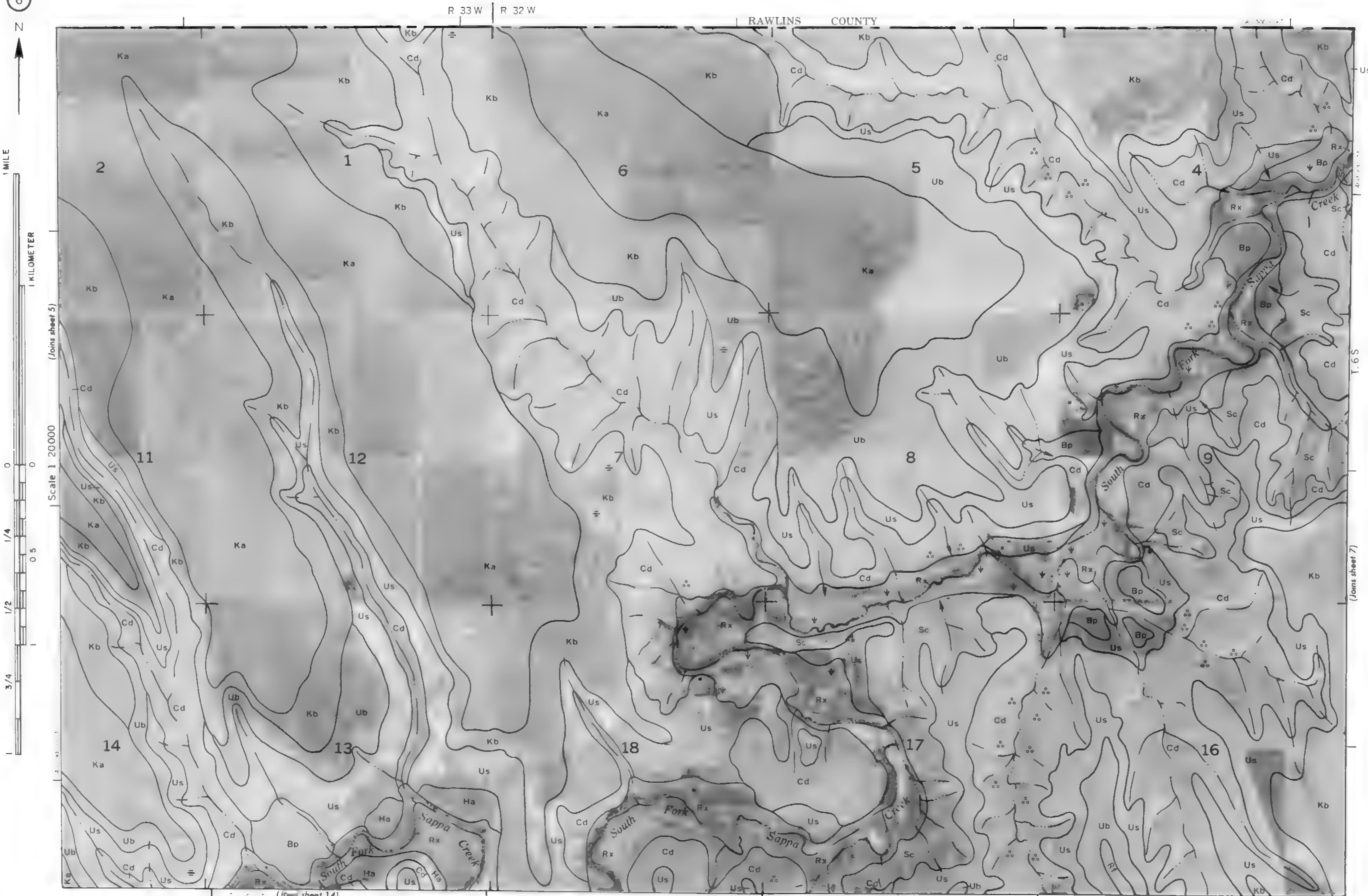
THOMAS COUNTY, KANSAS — SHEET NUMBER 3

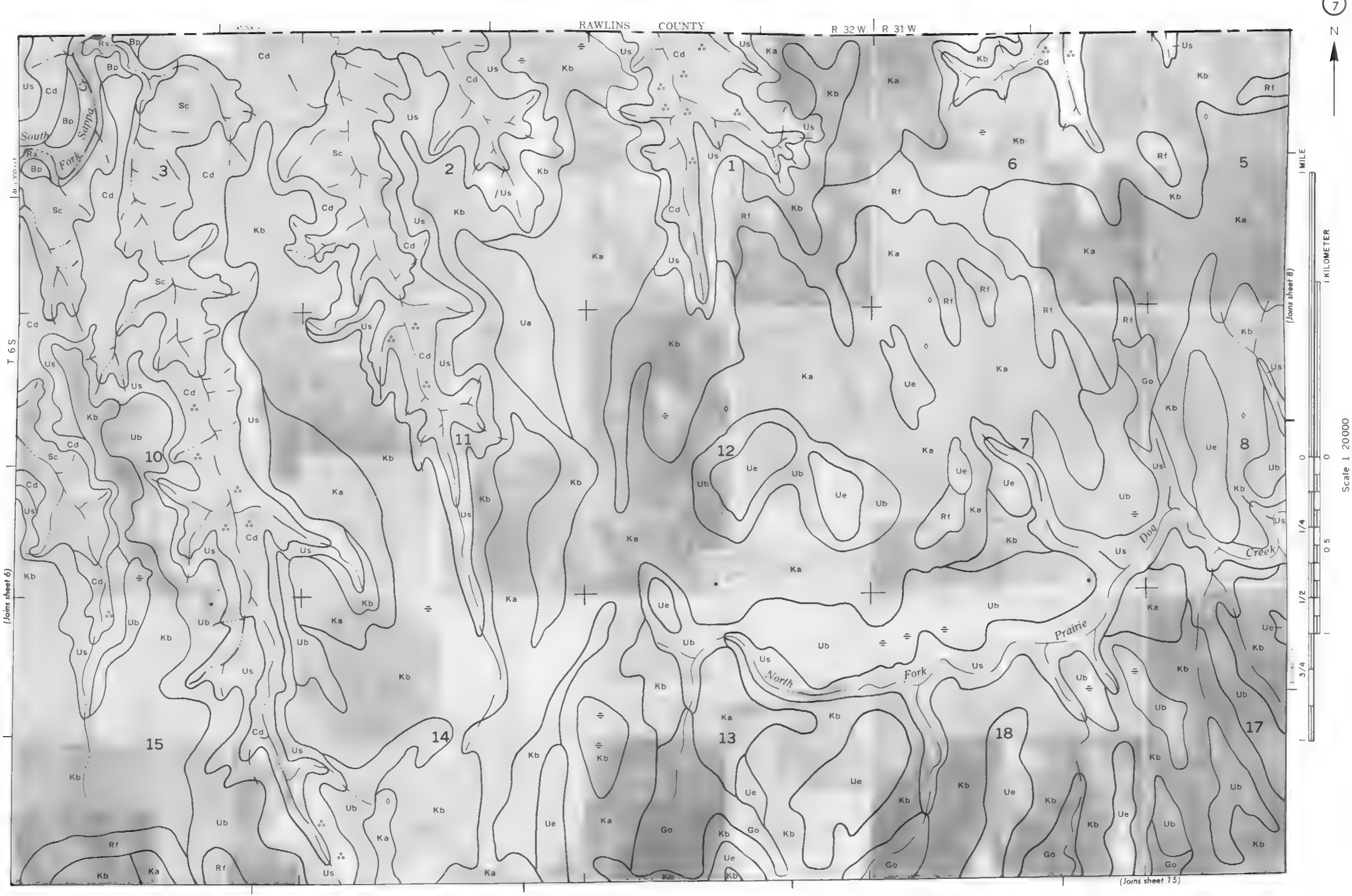


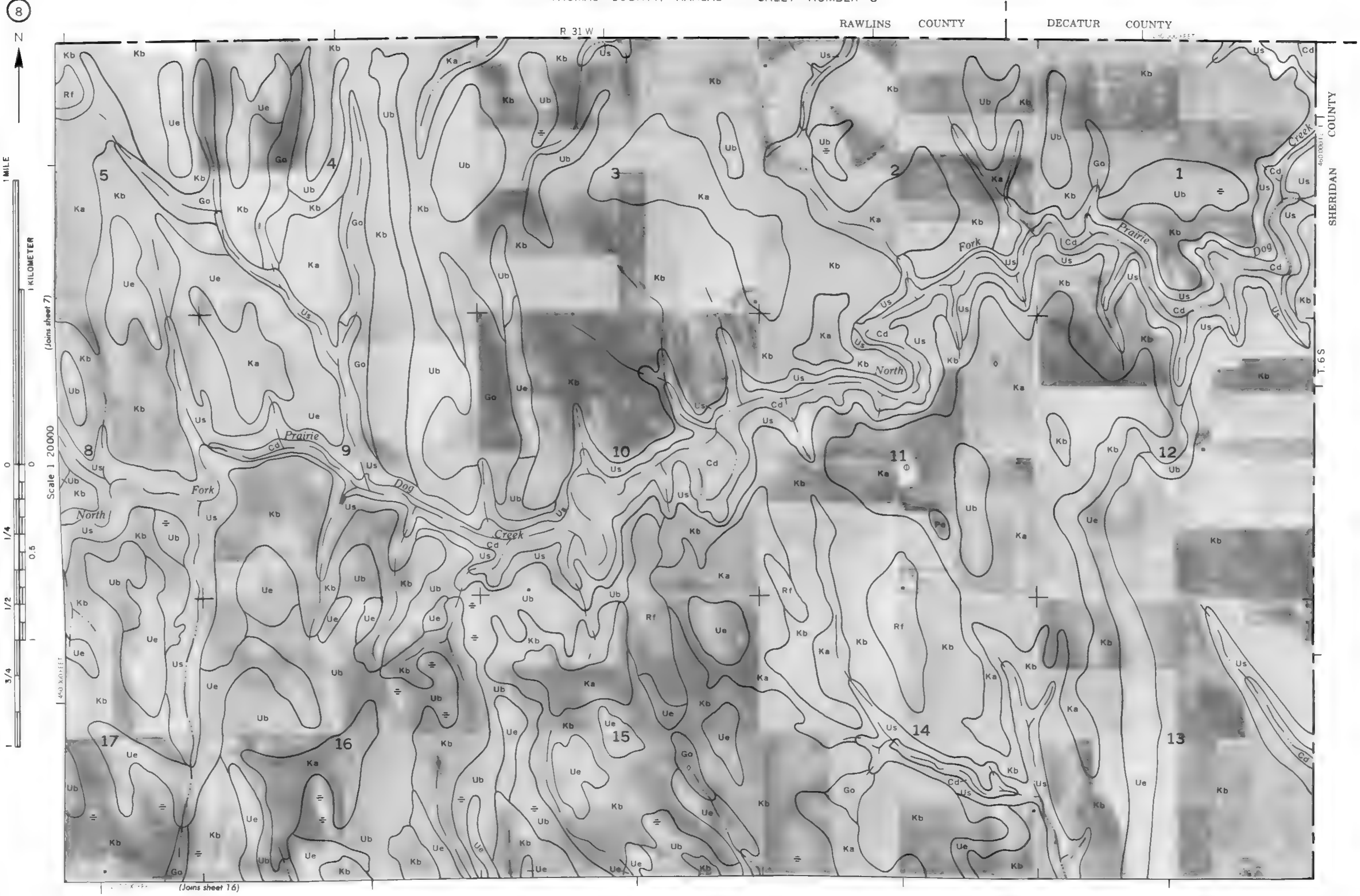
4

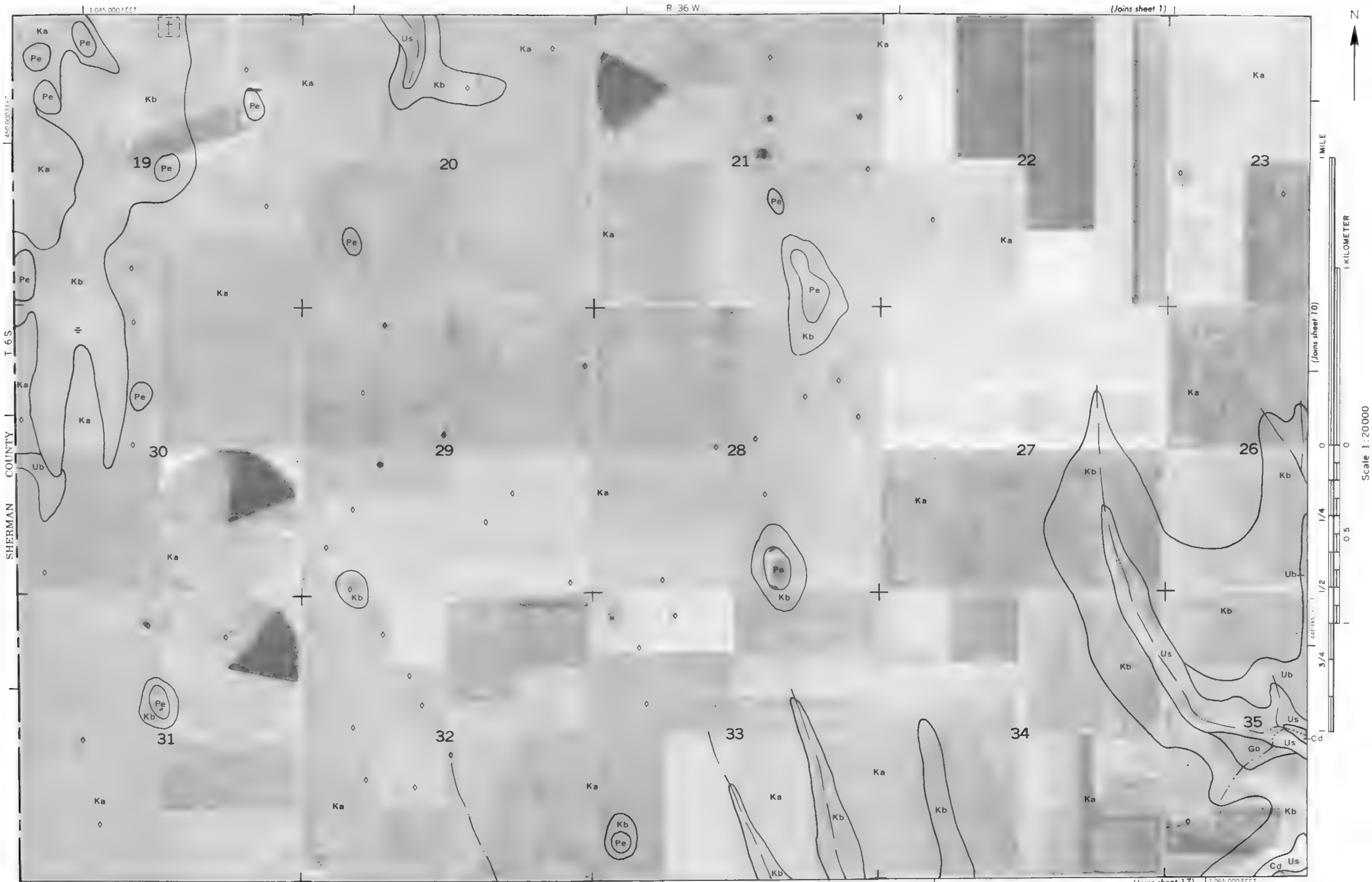

N
RAWLINS COUNTY
R 34 W
T 6 S
1 135 000 FEET
450 000 FEET
1 115 000 FEET
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 12)
Scale 1: 20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
25
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
Rx
Us
Cd
Kb
Ka
Ub
Pe
Ue
Go

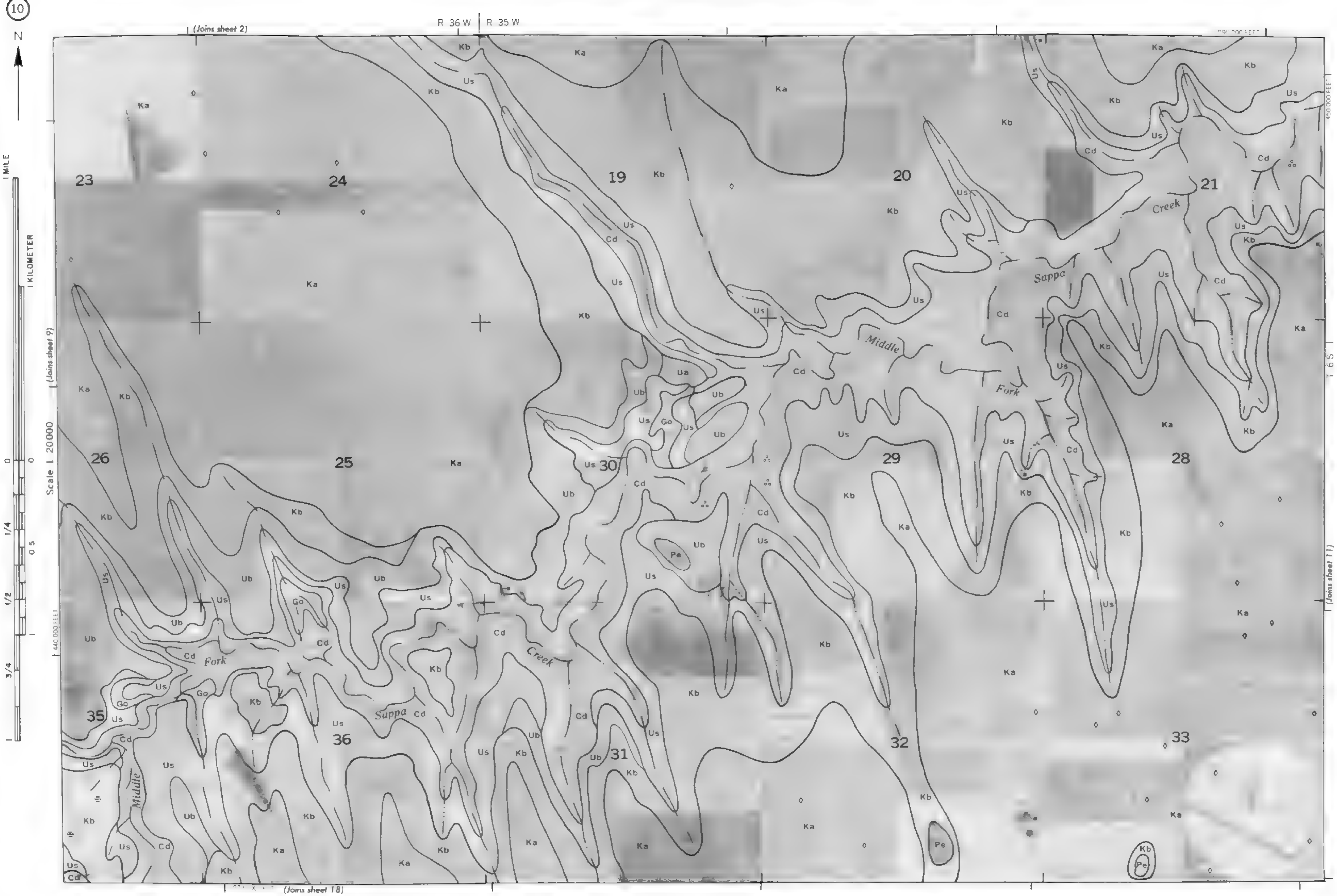

5
N
R. 33 W.
RAWLINS COUNTY
1 140 000 FEET
T 6 S
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 13)
1 160 000 FEET
450 000 FEET
6
5
4
3
2
7
8
9
10
11
18
17
16
15
14
Ka
Kb
Cd
Us
Pe
Ub
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1 20000


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
R 33 W
R 32 W
RAWLINS COUNTY
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 14)
T. 6 S.
South Fork Sappa Creek
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
Ka
Kb
Cd
Us
Ub
Rx
Bp
Sc
Ha

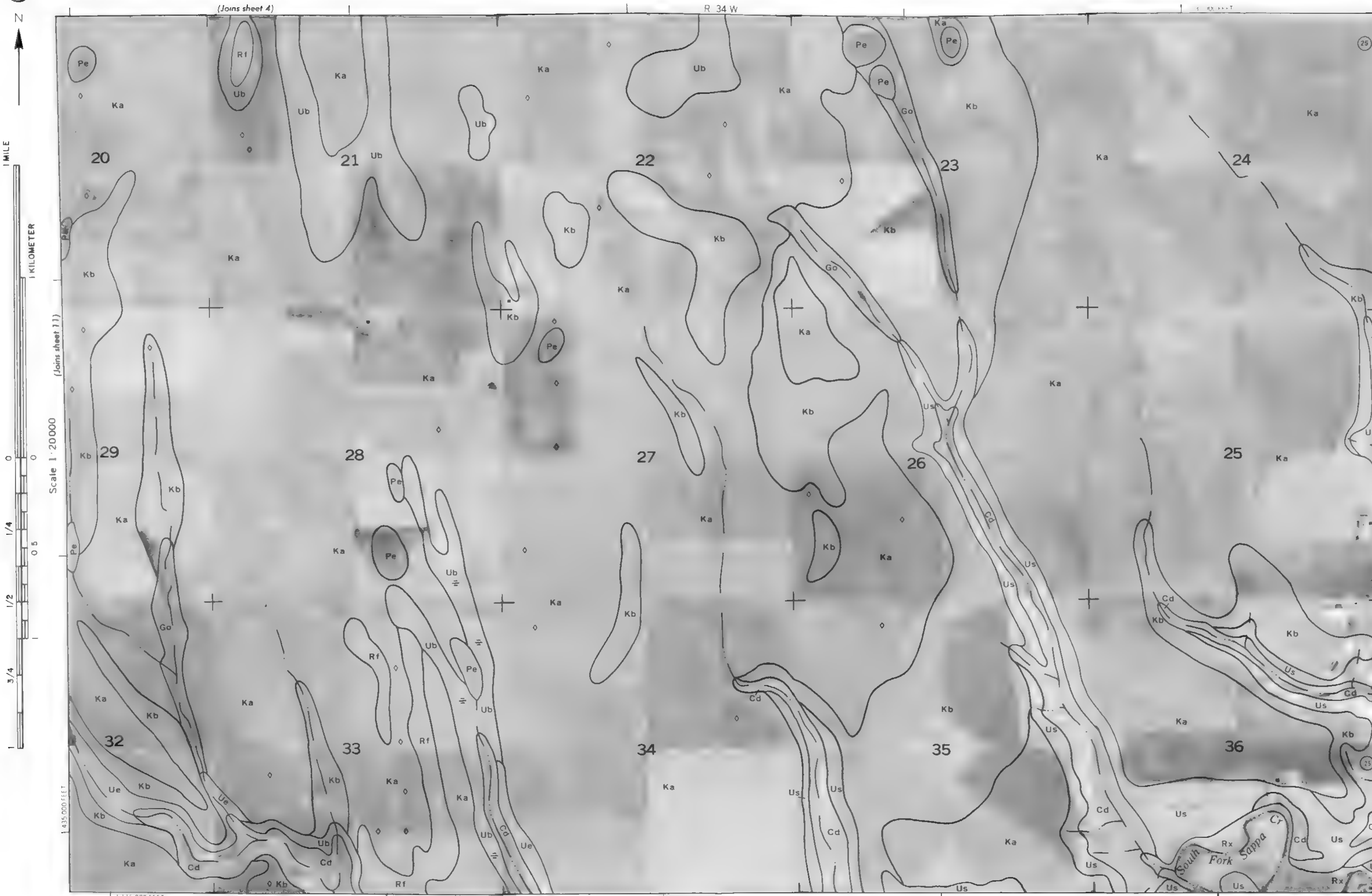

7
N
RAWLINS COUNTY
R 32 W.
R 31 W
T 6 S
South Fork Sappa Cr.
North Fork Prairie Dog Creek
(Joins sheet 6)
(Joins sheet 8)
(Joins sheet 15)
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

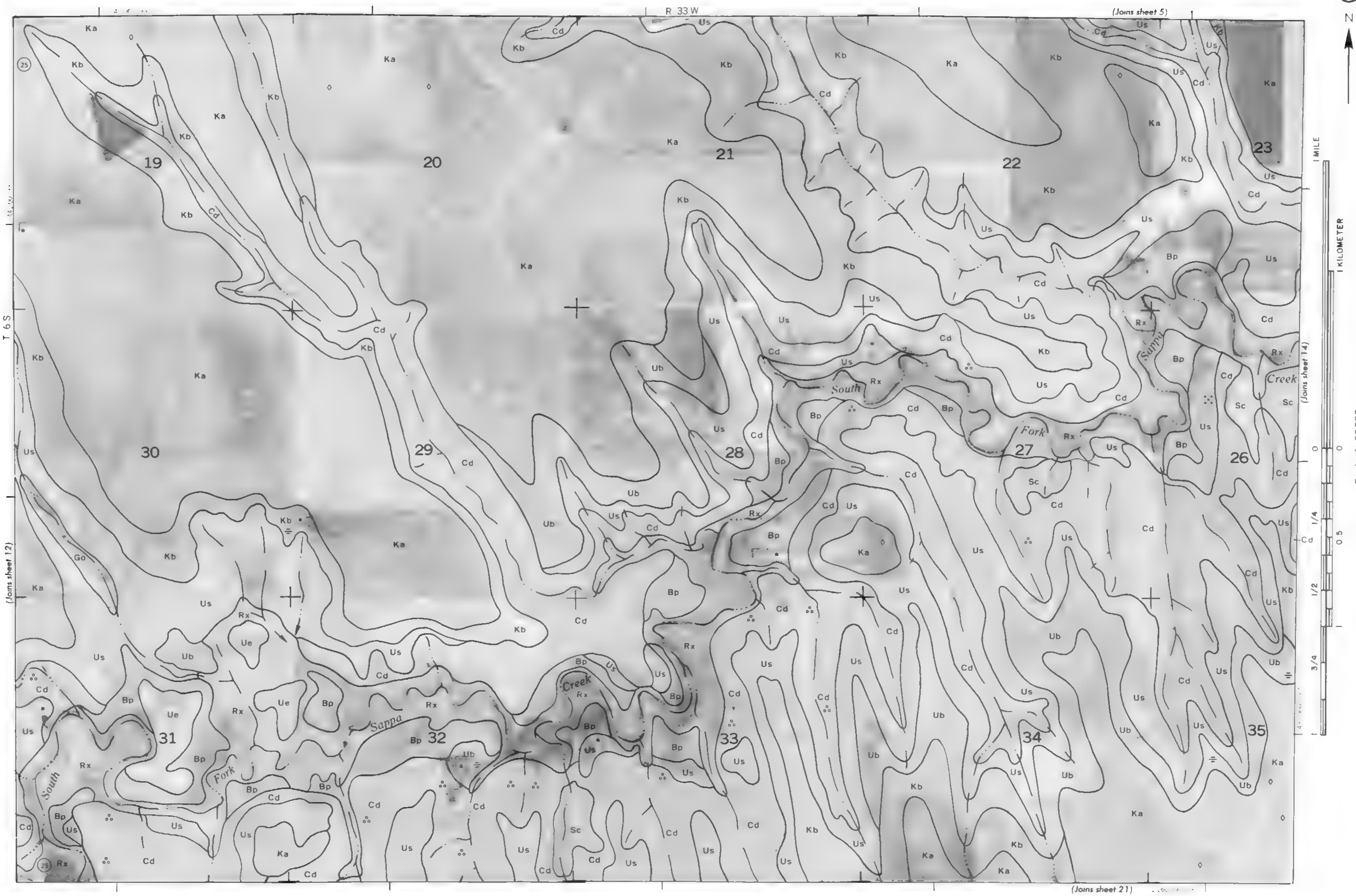

8
N
R 31 W
RAWLINS COUNTY
DECATUR COUNTY
SHERIDAN COUNTY
T. 6 S
(Joins sheet 7)
(Joins sheet 16)
1 MILE
1 KILOMETER
Scale 1:20000
North Fork Prairie Dog Creek

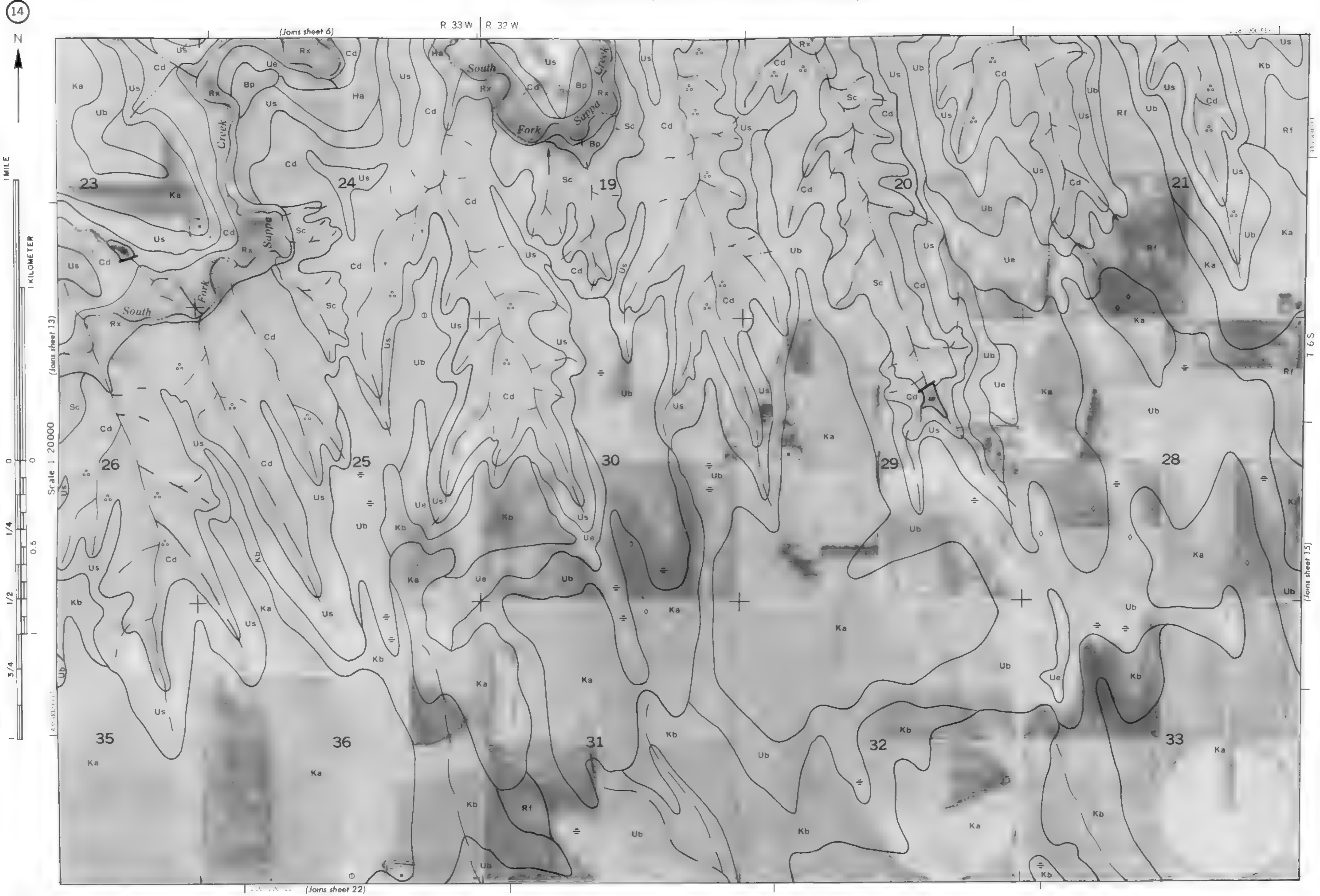

9
N
R 36 W
(Joins sheet 1)
(Joins sheet 10)
(Joins sheet 17)
1 045 000 FEET
1 065 000 FEET
T 6 S
SHERMAN COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
Ka
Kb
Pe
Us
Ub
Go
Cd

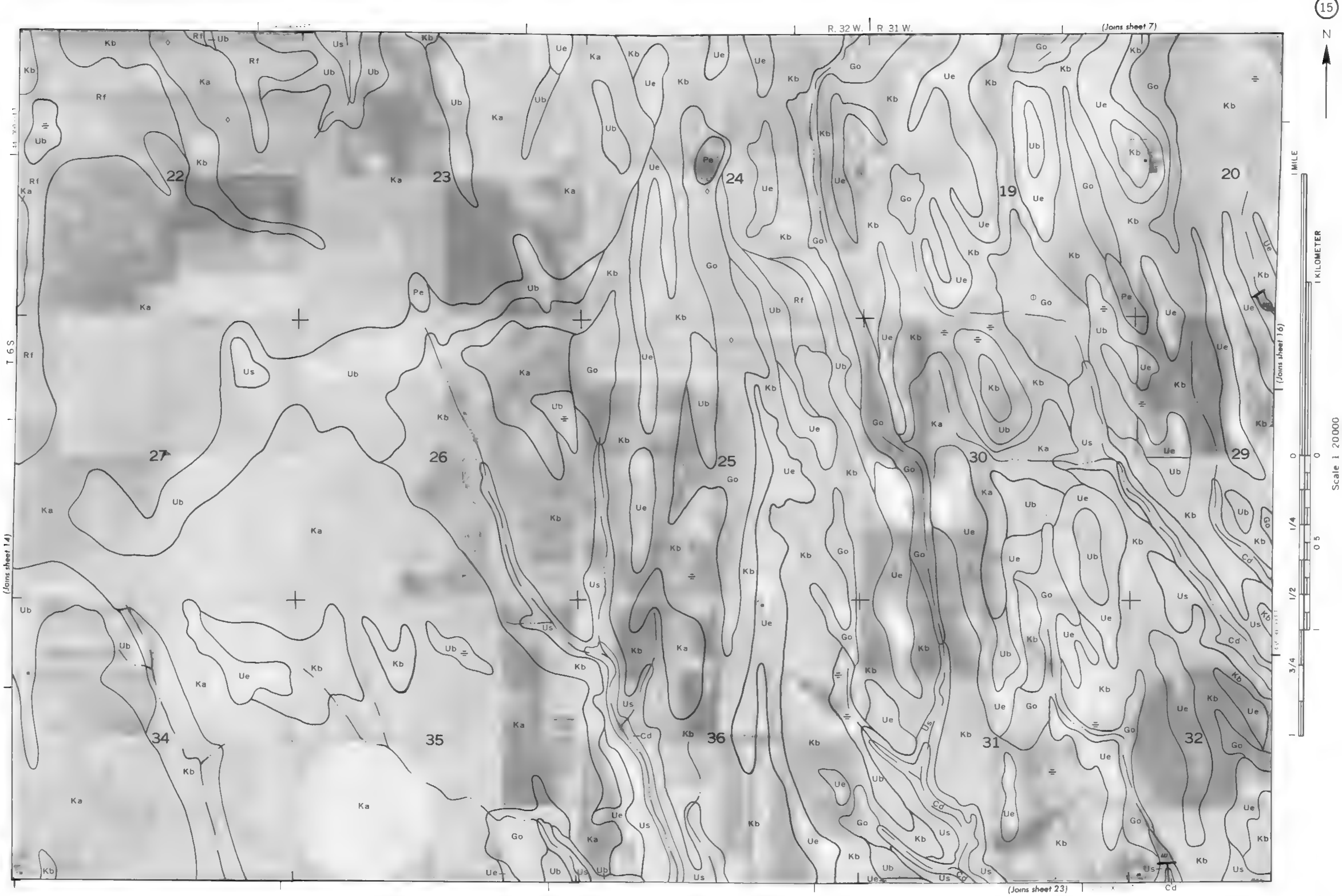

10
N
(Joins sheet 2)
R 36 W
R 35 W
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 18)
T 6 S
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
440 000 FEET
450 000 FEET
Middle Fork Sappa Creek
Middle
Fork
Sappa
Creek
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
Ka
Kb
Us
Cd
Ub
Ua
Go
Pe

THOMAS COUNTY, KANSAS — SHEET NUMBER 11

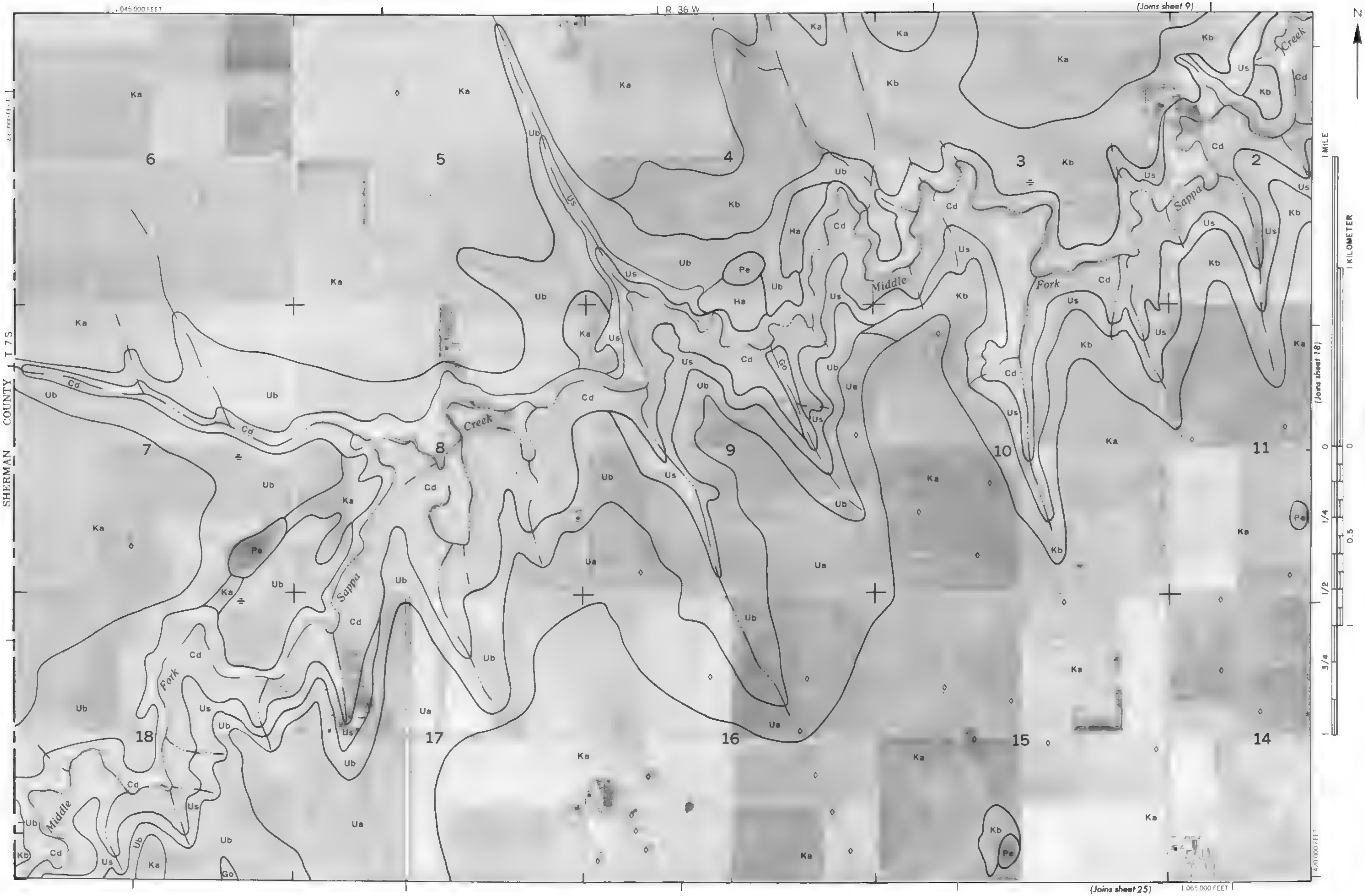

12
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1
(Joins sheet 4)
R 34 W
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 20)
T 6 S
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Ka
Kb
Pe
Rf
Ub
Ue
Us
Go
Cd
Rx
South Fork Sappa Cr
25

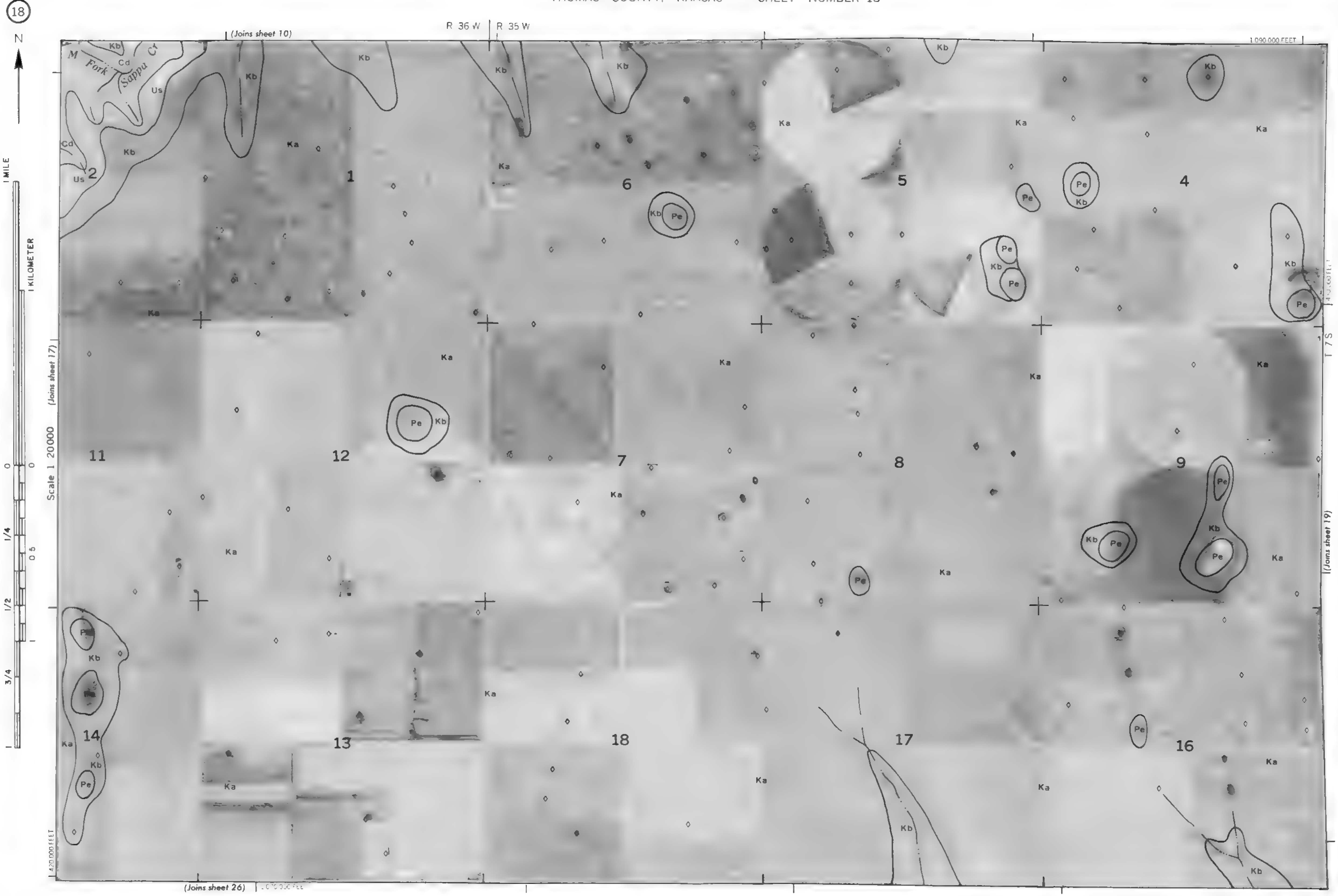

13
N
R 33 W
(Joins sheet 5)
(Joins sheet 14)
(Joins sheet 21)
(Joins sheet 12)
T 6 S
25
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
South Fork Sappa Creek
South
Fork
Sappa
Creek
Ka
Kb
Cd
Us
Ub
Ue
Bp
Rx
Sc
Go
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000

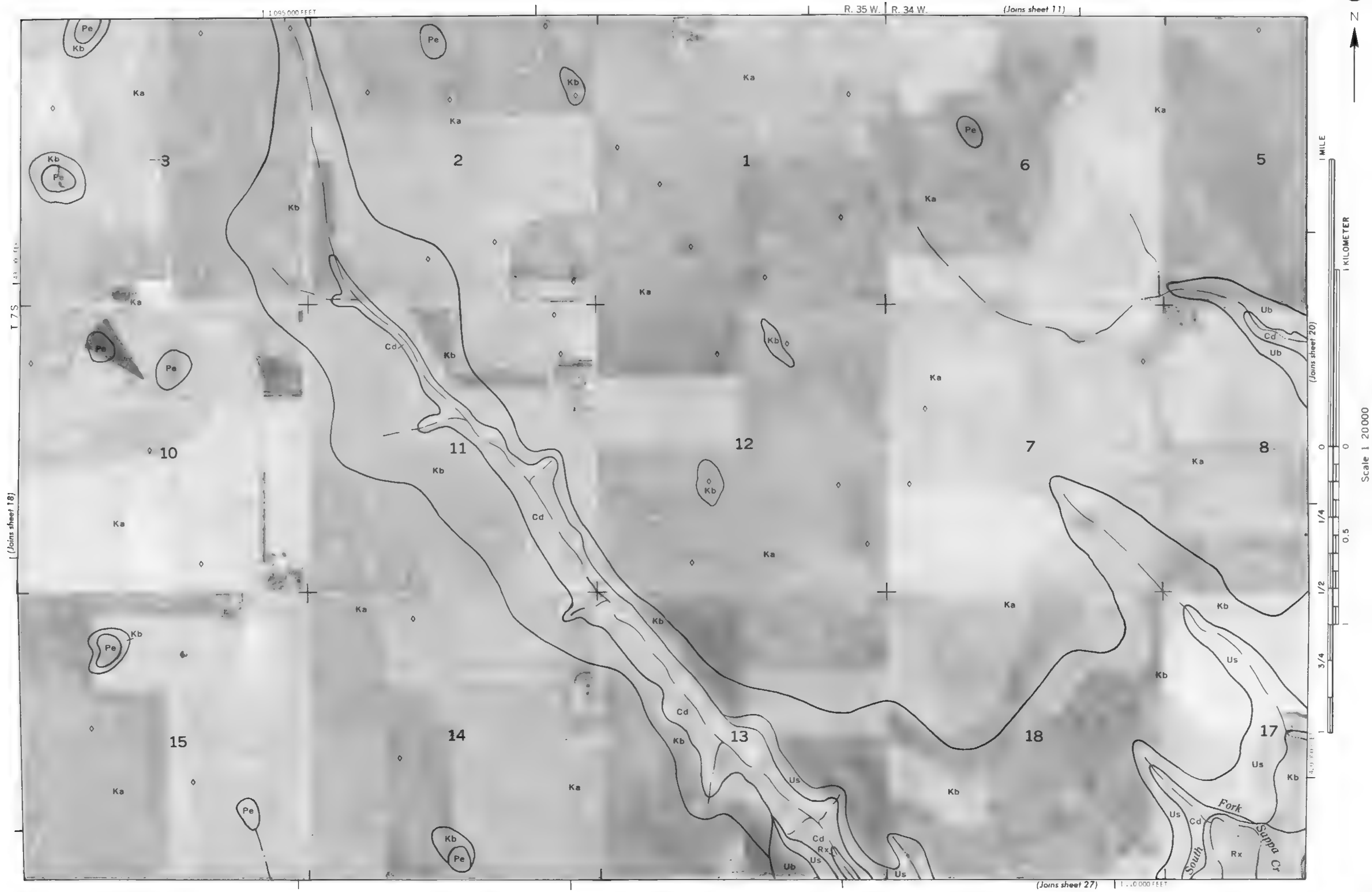

14
N
(Joins sheet 6)
R 33 W
R 32 W
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 22)
T 6 S
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
South Fork Sappa Creek
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33

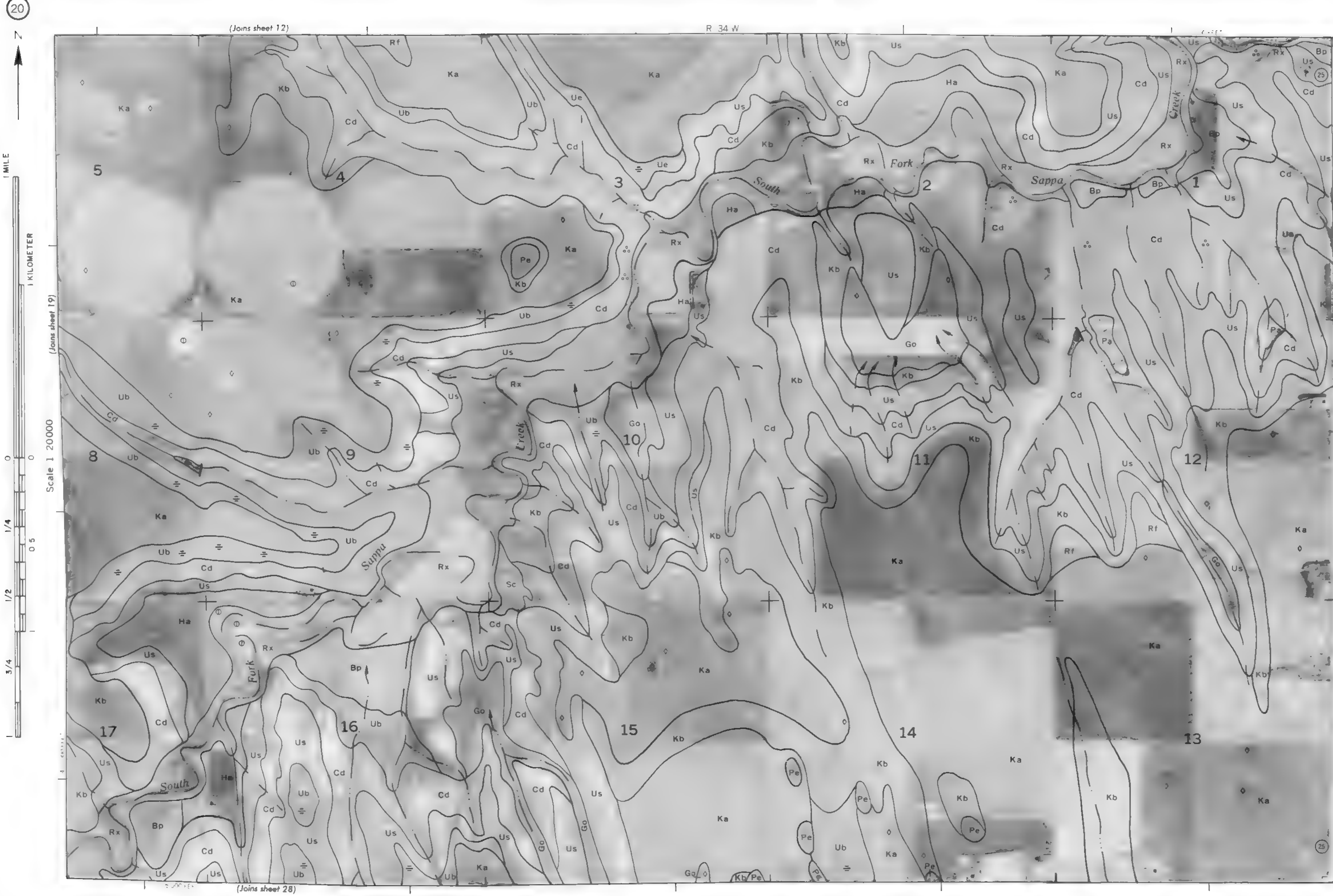

15
N
R. 32 W.
R. 31 W.
(Joins sheet 7)
(Joins sheet 16)
(Joins sheet 23)
(Joins sheet 14)
T 6 S
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
1 MILE
1 KILOMETER
Scale 1 20000
0
1/4
1/2
3/4
1
0
0.5
1

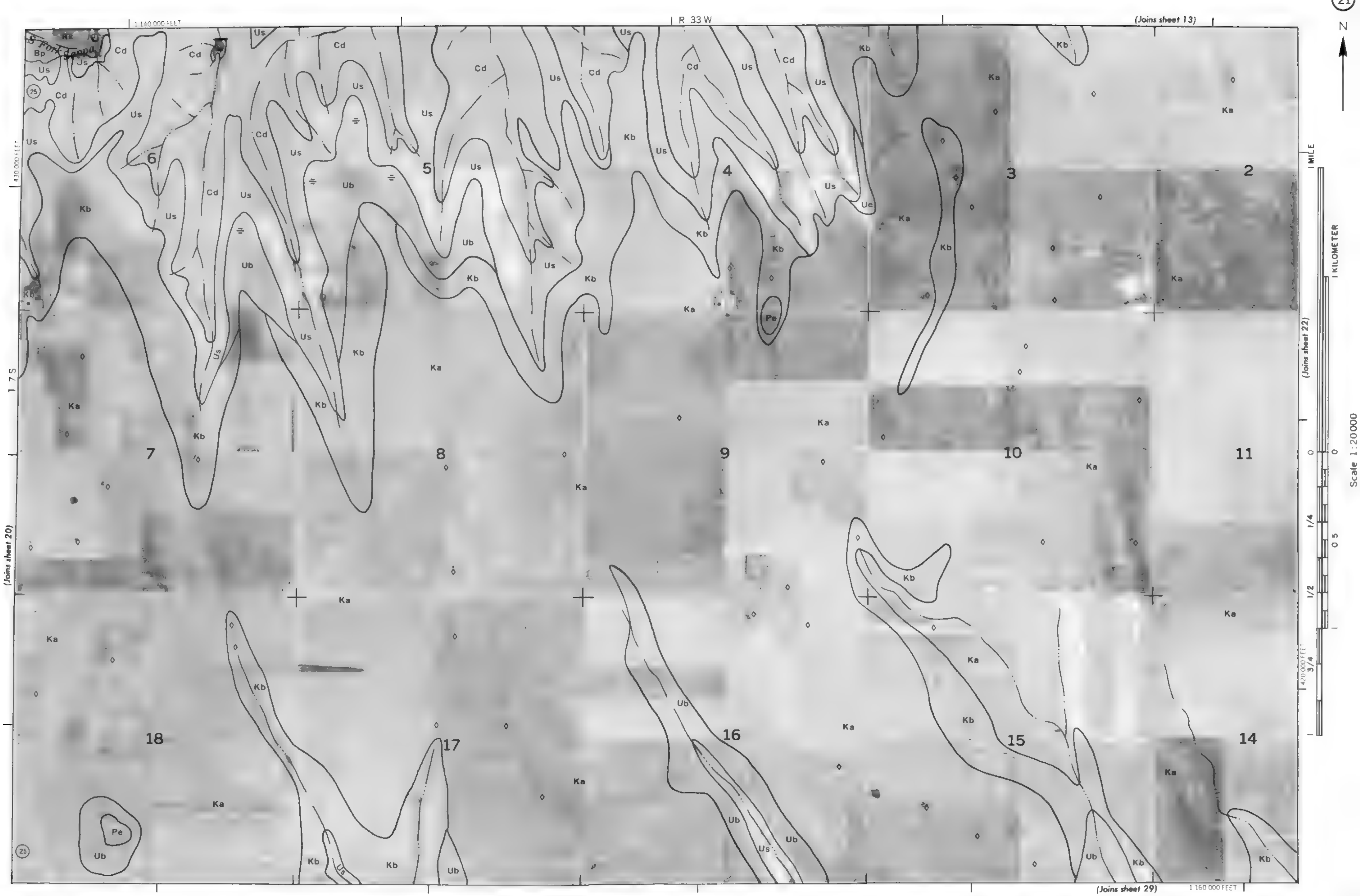

N
1 MILE
1 KILOMETER
Scale 1:20 000
(Joins sheet 8)
(Joins sheet 15)
(Joins sheet 24)
R 31 W
T 6 S
SHERIDAN COUNTY
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Prairie Dog Creek
Prairie Dog Creek
Prairie
Kb
Ka
Ub
Ue
Us
Go
Cd
Ha
Rx
Rf

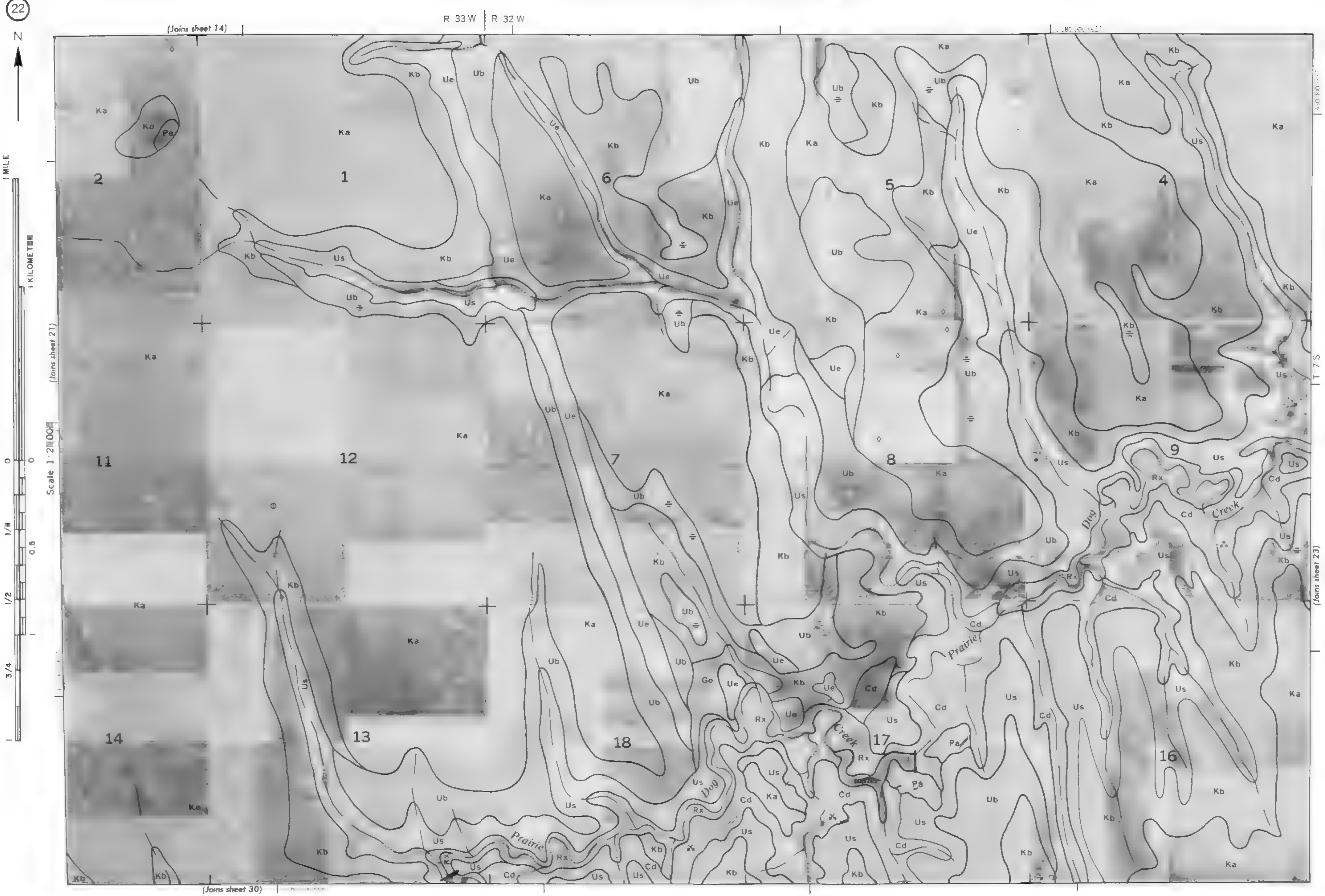

17
N
(Joins sheet 9)
R. 36 W.
T. 7 S.
SHERMAN COUNTY
(Joins sheet 18)
(Joins sheet 25)
1 065 000 FEET
Middle Fork Sappa Creek
Sappa Creek
Middle Fork
1 MILE
1 KILOMETER
Scale 1:20000
6
5
4
3
2
7
8
9
10
11
18
17
16
15
14
Ka
Kb
Ub
Us
Ua
Cd
Ha
Pe
Go


18
N
(Joins sheet 10)
R 36 W
R 35 W
1 090 000 FEET
M Fork Sappa Cr
Kb
Cd
Us
Ka
Pe
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
T 7 S
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 26)
1 MILE
1 KILOMETER
Scale 1 20000
0
1/4
1/2
3/4
0.5
1
420 000 FEET


1 095 000 FEET
R. 35 W.
R. 34 W.
(Joins sheet 11)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 27)
T 7 S
N
1 MILE
1 KILOMETER
Scale 1 : 20000
0
1/4
1/2
3/4
1
0
0.5
1
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
Ka
Kb
Pe
Cd
Ub
Us
Rx
South Fork Sappa Cr

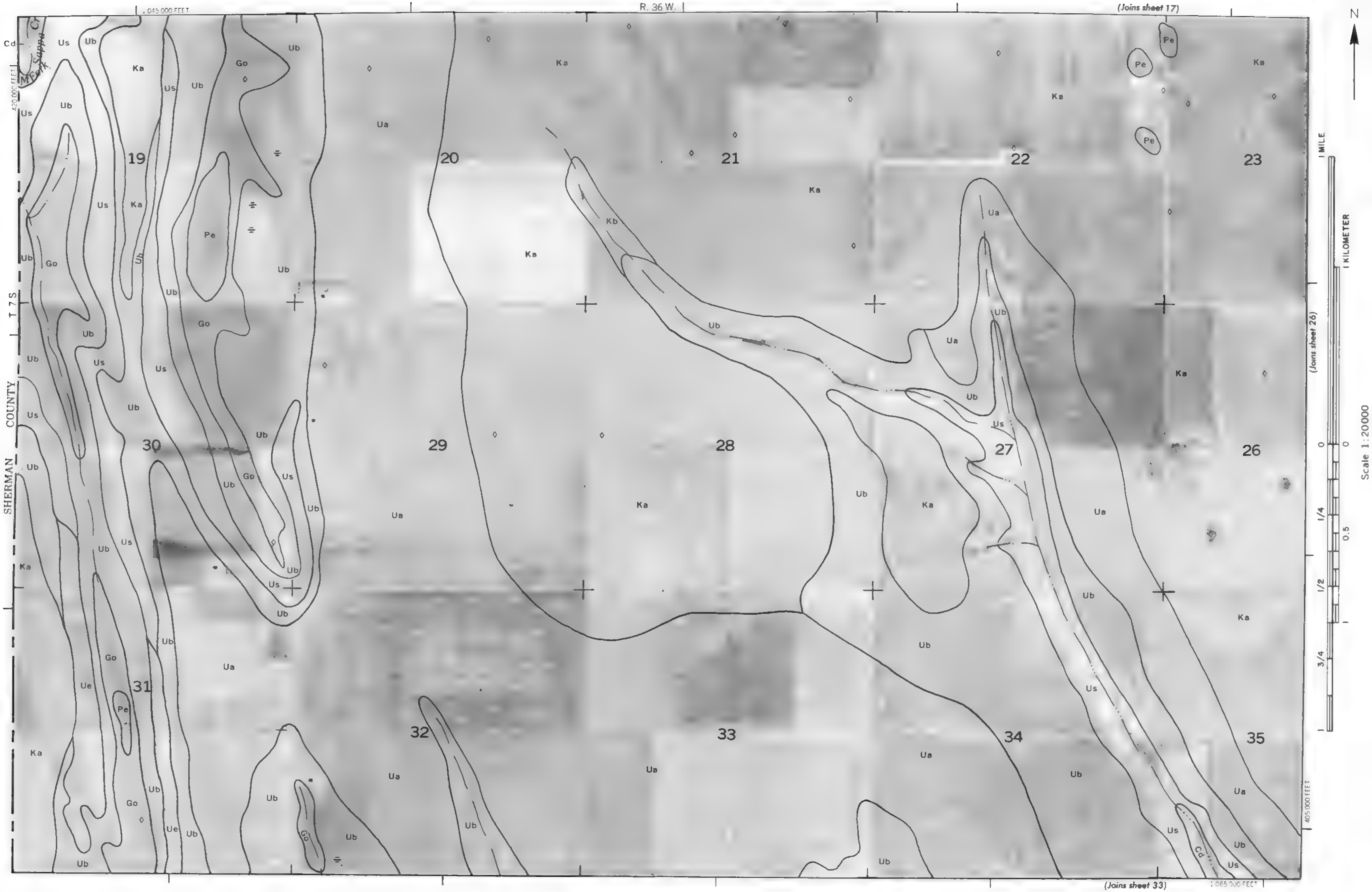

20
(Joins sheet 12)
R 34 W
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 28)
T 7 S
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
South Fork Sappa Creek
Suppa Creek
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
Ka
Kb
Cd
Us
Ub
Ue
Ha
Rx
Rf
Bp
Go
Pe
Pa
Sc
25


21
N
1 140 000 FEET
R 33 W
(Joins sheet 13)
430 000 FEET
T 7 S
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 29)
1 160 000 FEET
420 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
S Fork Sappa
25
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
Bp
Us
Js
Cd
Kb
Ka
Ub
Ue
Pe

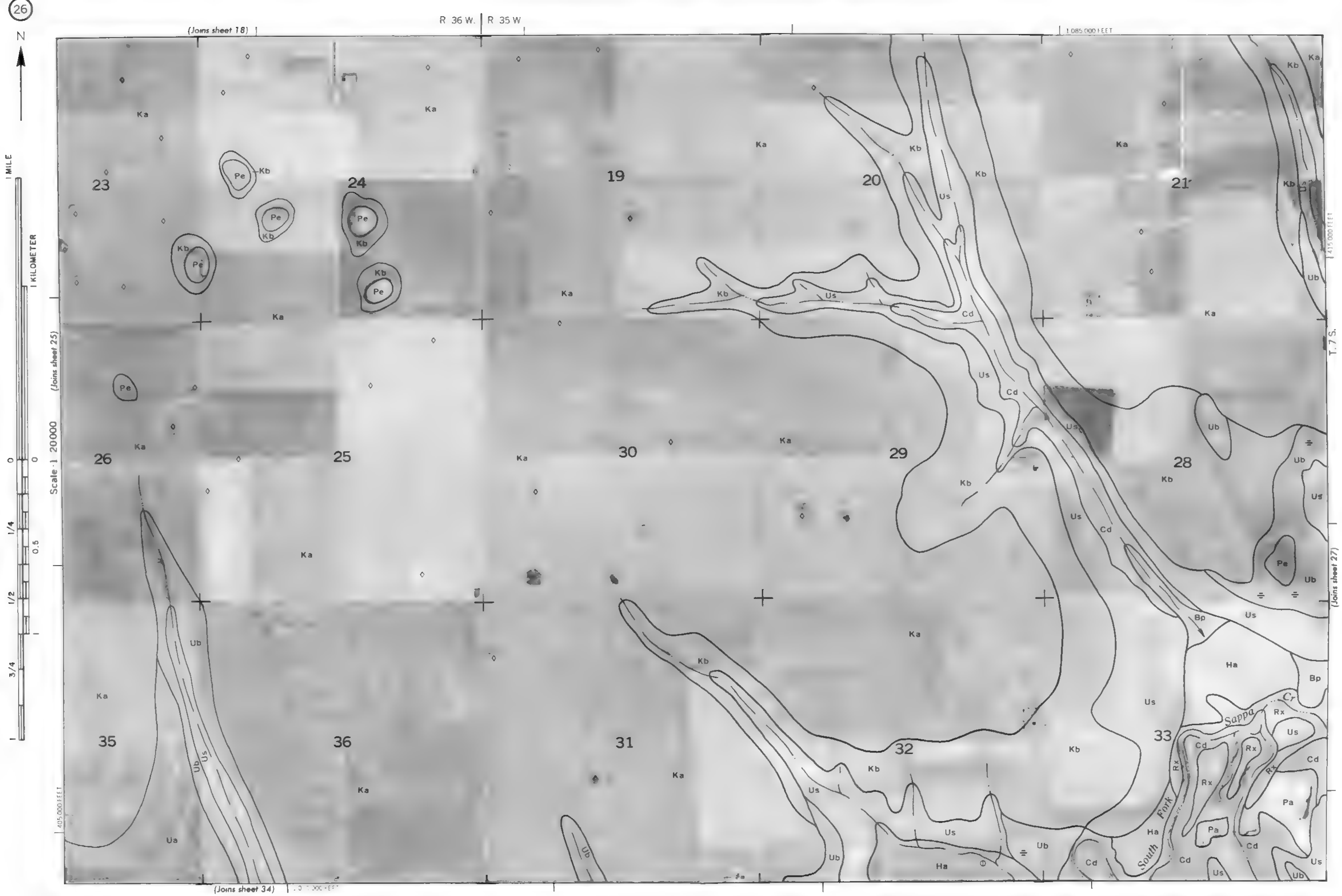

22
N
R 33 W
R 32 W
(Joins sheet 14)
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 30)
T 7 S
1 MILE
1 KILOMETER
Scale 1:24 000
0
1/4
1/2
3/4
0.5
1
2
3
4
5
6
7
8
9
11
12
13
14
16
17
18
Dog Creek
Prairie Dog Creek
Prairie
water
Ka
Kb
Pe
Ue
Ub
Us
Rx
Cd
Go
Pa

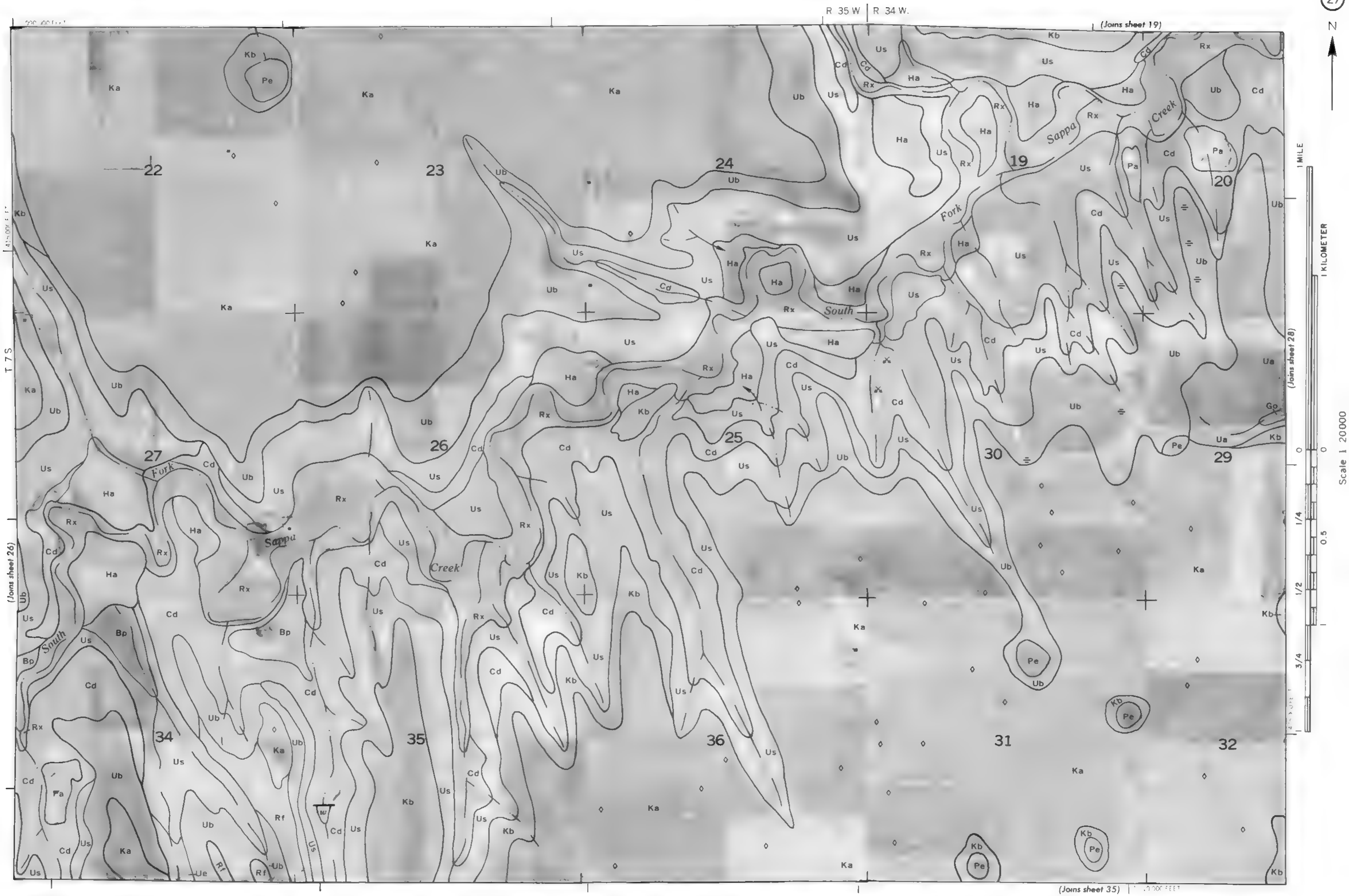

23
N
R. 32 W.
R. 31 W.
(Joins sheet 15)
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 31)
T. 7 S.
Dog Creek
Prairie
Dog
Creek
Prairie
Breton
CHICAGO
ROCK
ISLAND
AND
PACIFIC
83
383
1 MILE
1 KILOMETER
Scale 1:20000

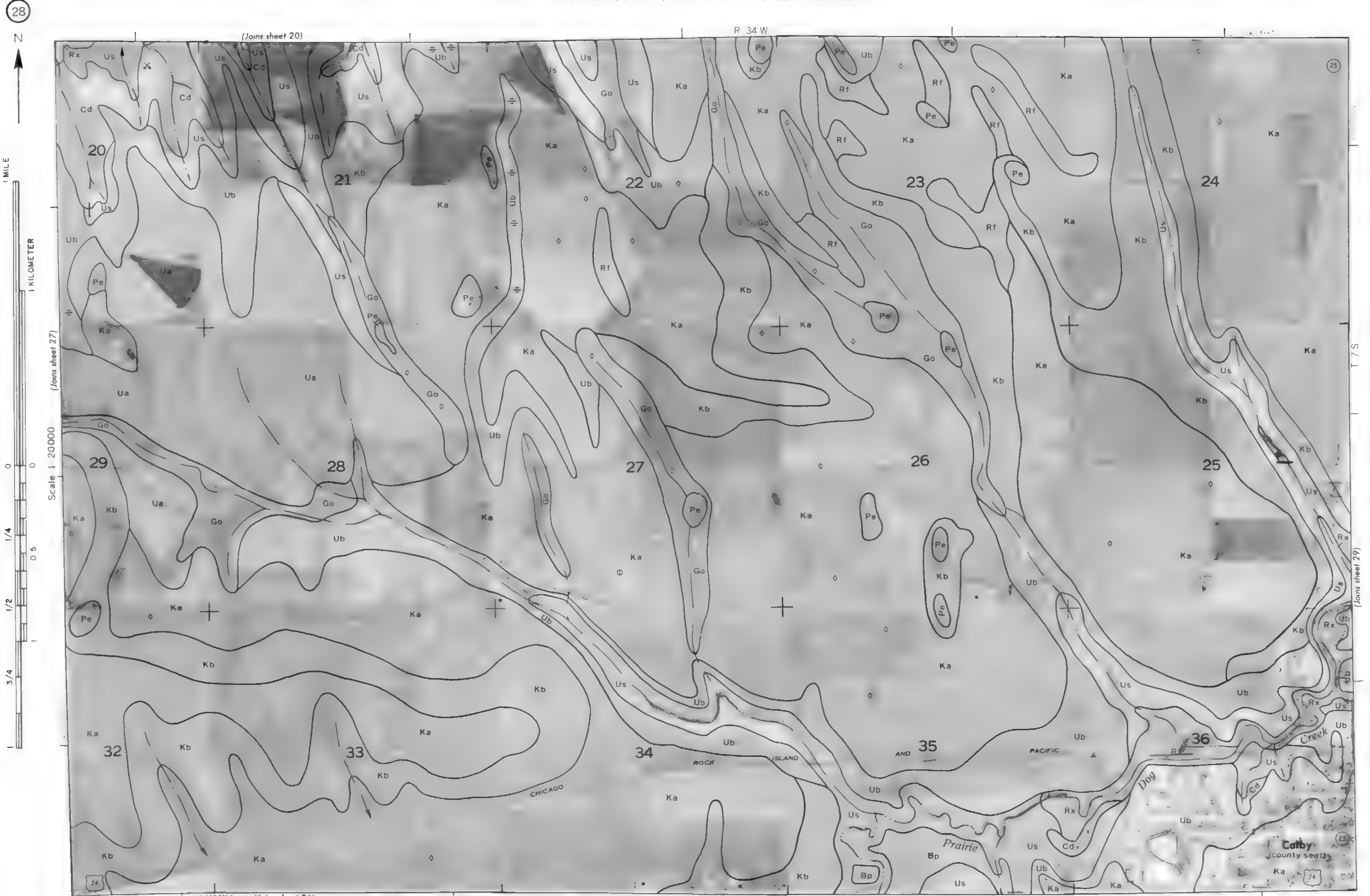

24
N
(Joins sheet 16)
R. 31 W.
1 230 000 FEET
(Joins sheet 23)
(Joins sheet 32)
T. 7 S.
SHERIDAN COUNTY
425 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
Prairie
Dog
Creek
Rexford
ROCK ISLAND AND PACIFIC
CHICAGO
REXFORD CEMETERY
83
383
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
Us
Rx
Cd
Kb
Ka
Rf
Pe
Ue
Go

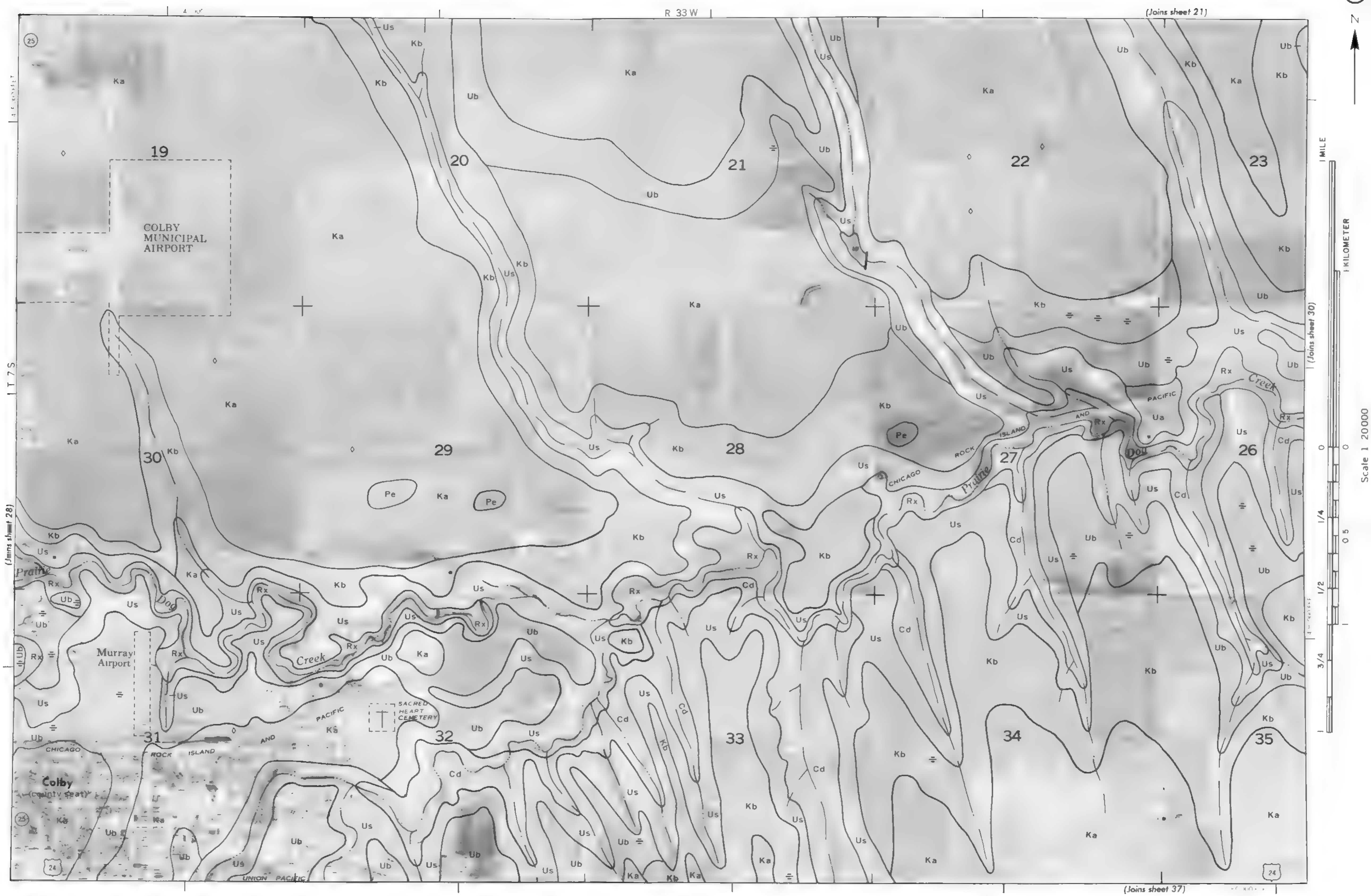

25
N
R. 36 W.
(Joins sheet 17)
(Joins sheet 26)
(Joins sheet 33)
T 7 S
SHERMAN COUNTY
1 045 000 FEET
420 000 FEET
405 000 FEET
1 065 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35
Ka
Ub
Us
Ua
Go
Pe
Kb
Ue
Cd

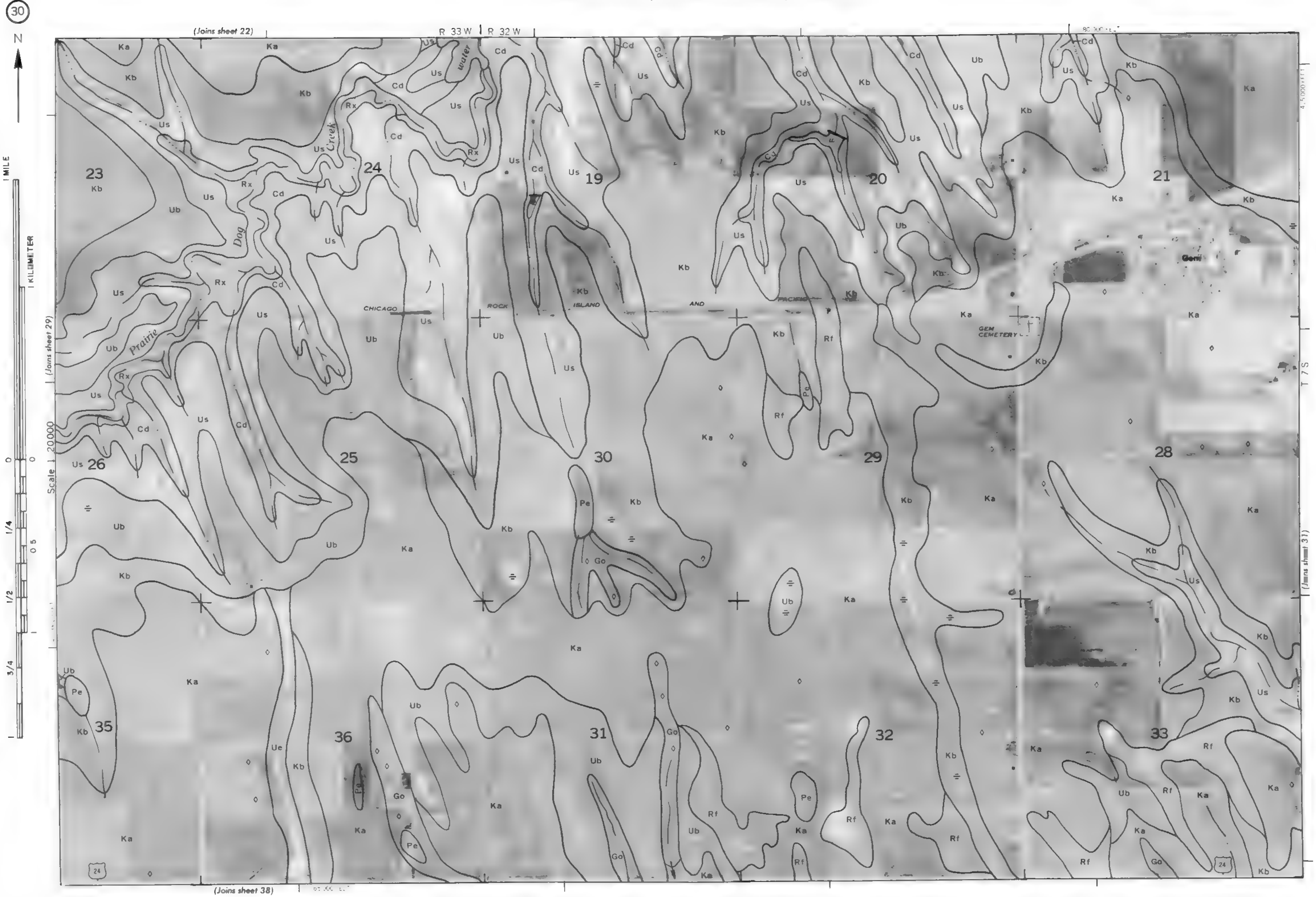
26

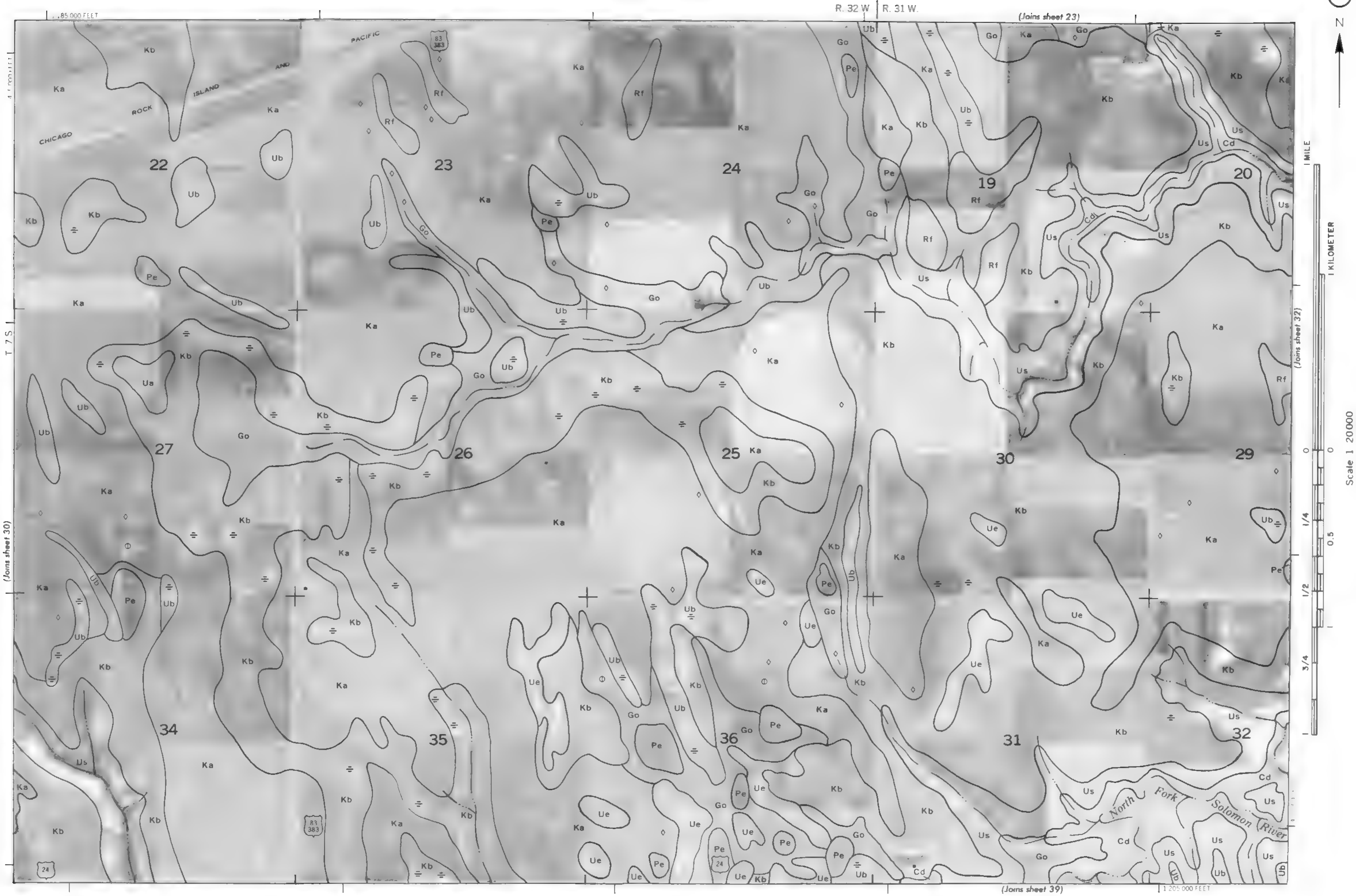

N
R 36 W.
R 35 W
(Joins sheet 18)
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 34)
T. 7 S.
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
1 085 000 FEET
415 000 FEET
405 000 FEET
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
Ka
Kb
Pe
Us
Cd
Ub
Bp
Ha
Rx
Pa
Ua
Sappa Cr
South Fork

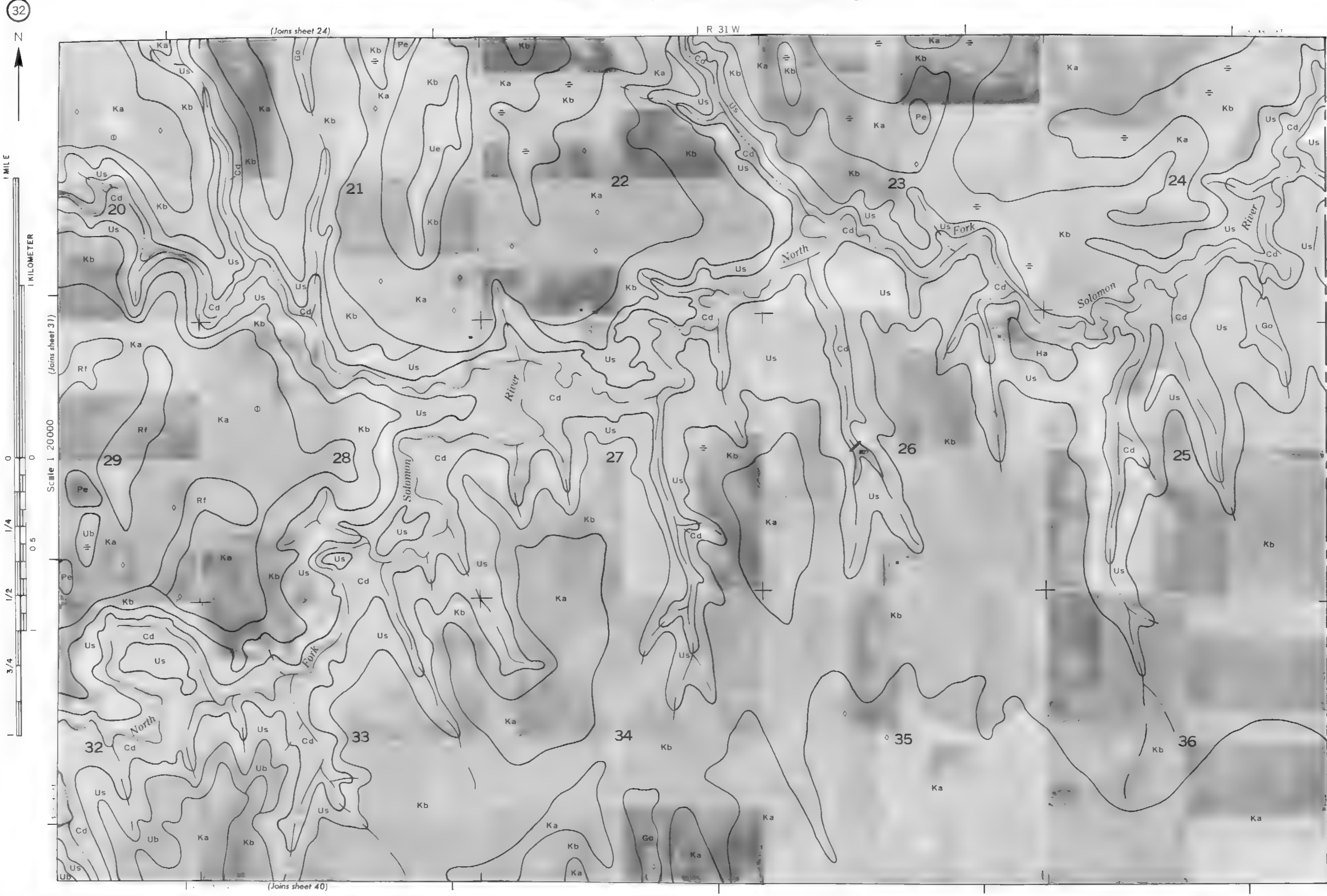

27
N
R 35 W
R 34 W.
(Joins sheet 19)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 35)
T 7 S
1 MILE
1 KILOMETER
Scale 1 20000
1/4
1/2
3/4
0.5
0
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
South
Fork
Sappa
Creek
Ka
Kb
Pe
Pa
Us
Ub
Ua
Ha
Rx
Cd
Bp
Rf
Ue
Go

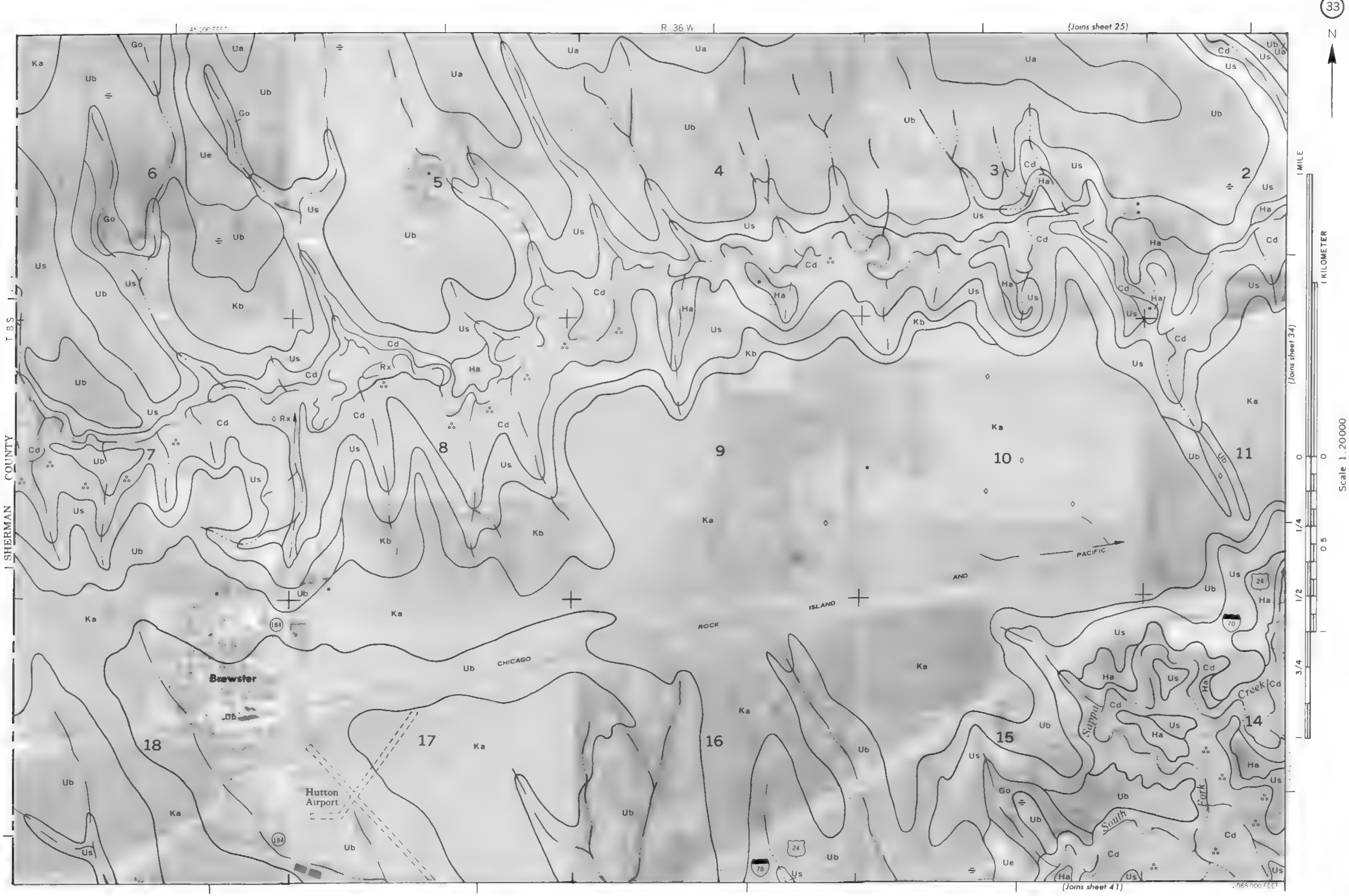

28
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0
0.5
1
(Joins sheet 20)
R 34 W
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 36)
T 7 S
115 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
CHICAGO
ROCK
ISLAND
AND
PACIFIC
Prairie
Dog
Creek
Colby
(county seat)
24
25
Ka
Kb
Ub
Us
Ua
Go
Pe
Rf
Rx
Cd
Bp


29
N
R 33 W
(Joins sheet 21)
(Joins sheet 30)
(Joins sheet 28)
(Joins sheet 37)
T 7 S
COLBY MUNICIPAL AIRPORT
Murray Airport
SACRED HEART CEMETERY
Colby (county seat)
Prairie Dog Creek
CHICAGO ROCK ISLAND AND PACIFIC
UNION PACIFIC
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
1 MILE
1 KILOMETER
Scale 1 : 20000

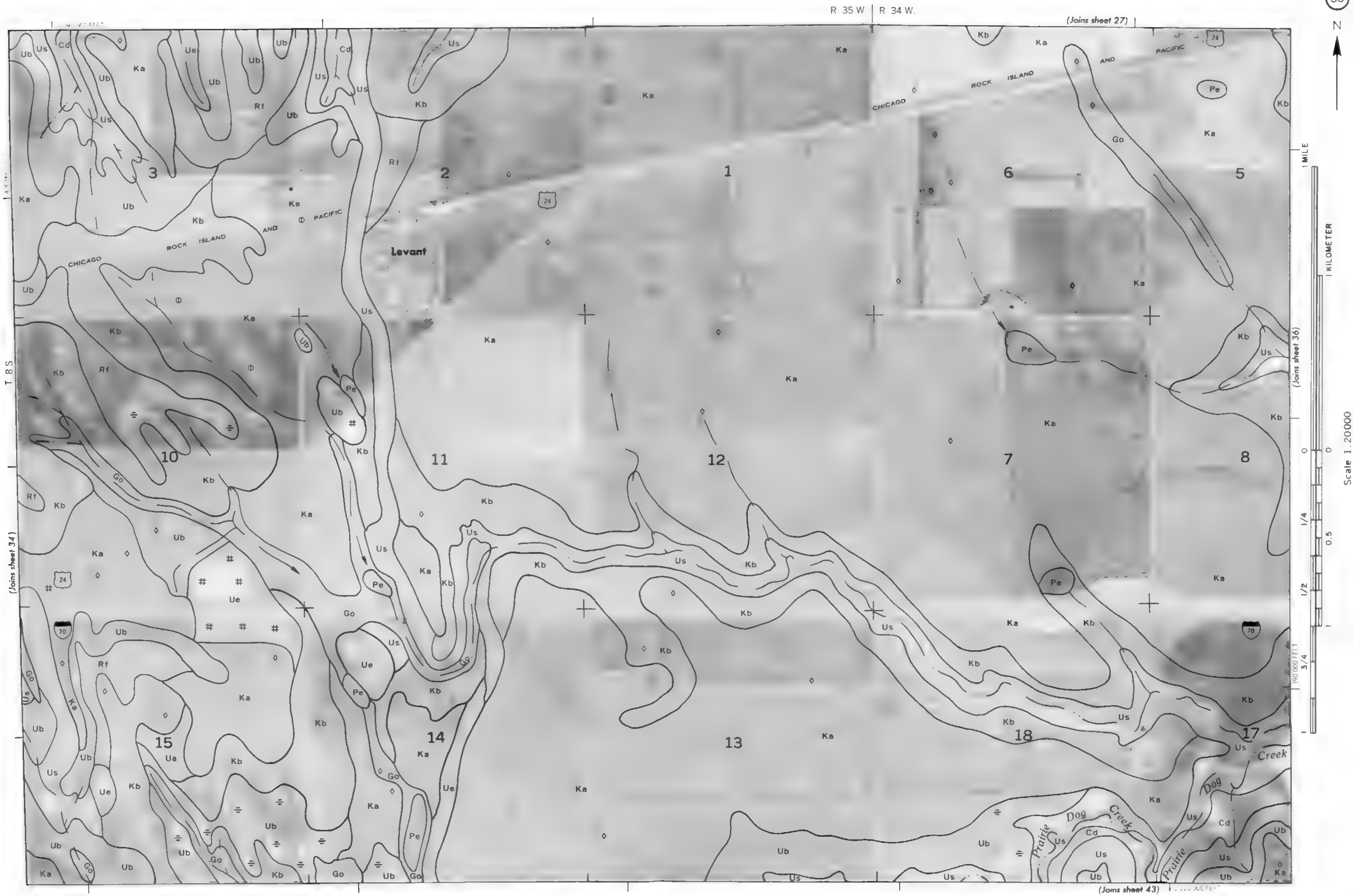

30
N
(Joins sheet 22)
R 33 W
R 32 W
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 38)
T 7 S
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
Dog
Creek
Prairie
water
CHICAGO
ROCK
ISLAND
AND
PACIFIC
GEM
CEMETERY
Gem
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
24
24
Ka
Kb
Us
Ub
Cd
Rx
Rf
Pe
Go
Ue


31
N
R. 32 W. | R. 31 W.
(Joins sheet 23)
(Joins sheet 32)
(Joins sheet 39)
(Joins sheet 30)
85 000 FEET
1 205 000 FEET
T. 7 S.
CHICAGO ROCK ISLAND AND PACIFIC
North Fork Solomon River
83
383
24
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
Ka
Kb
Ub
Ua
Ue
Us
Pe
Go
Rf
Cd
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

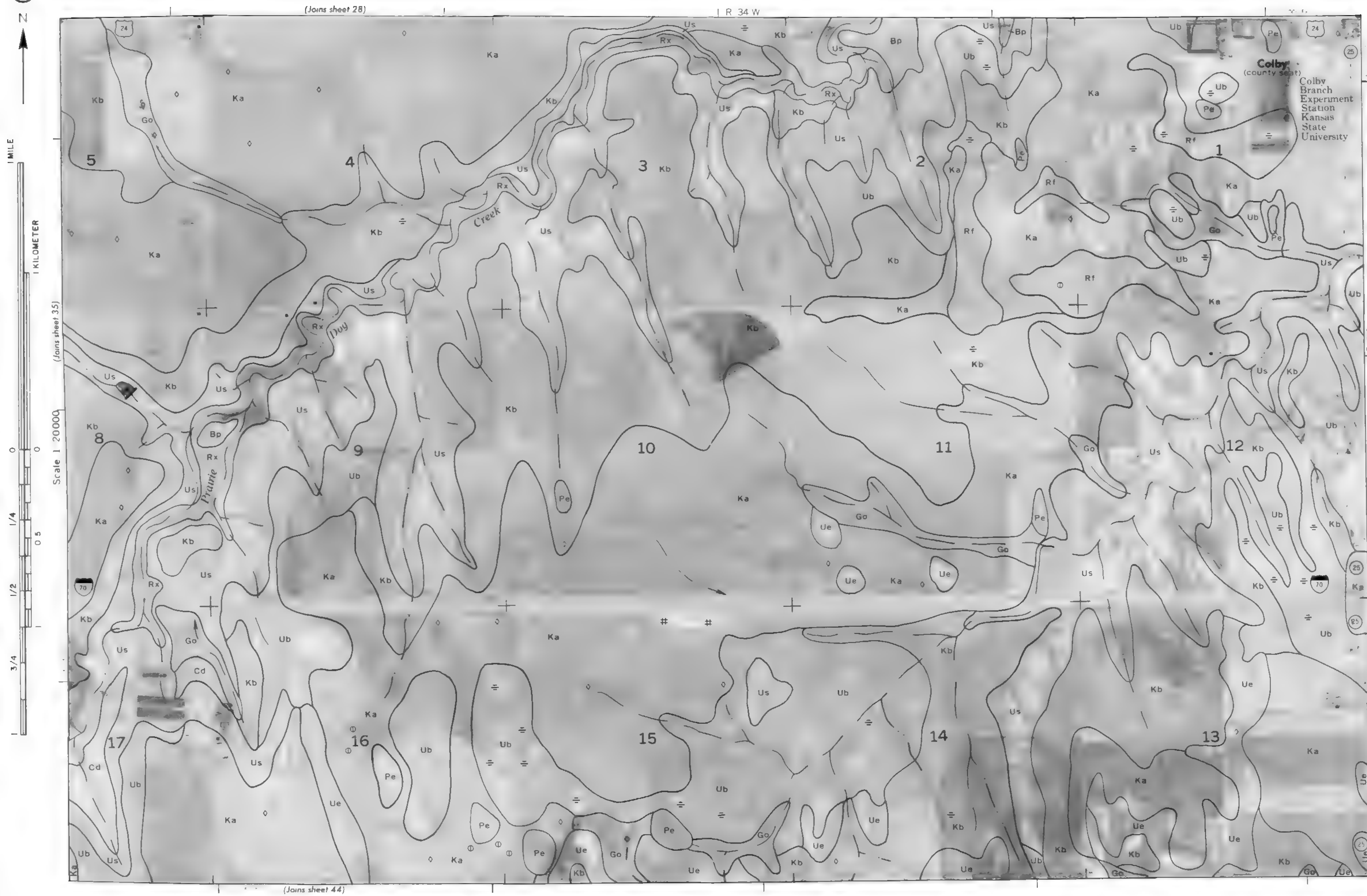

32
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:20000
(Joins sheet 24)
R 31 W
(Joins sheet 31)
(Joins sheet 40)
T 7 S
SHERIDAN COUNTY
North Fork Solomon River
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Ka
Kb
Us
Cd
Pe
Go
Ue
Rf
Ub
Ha

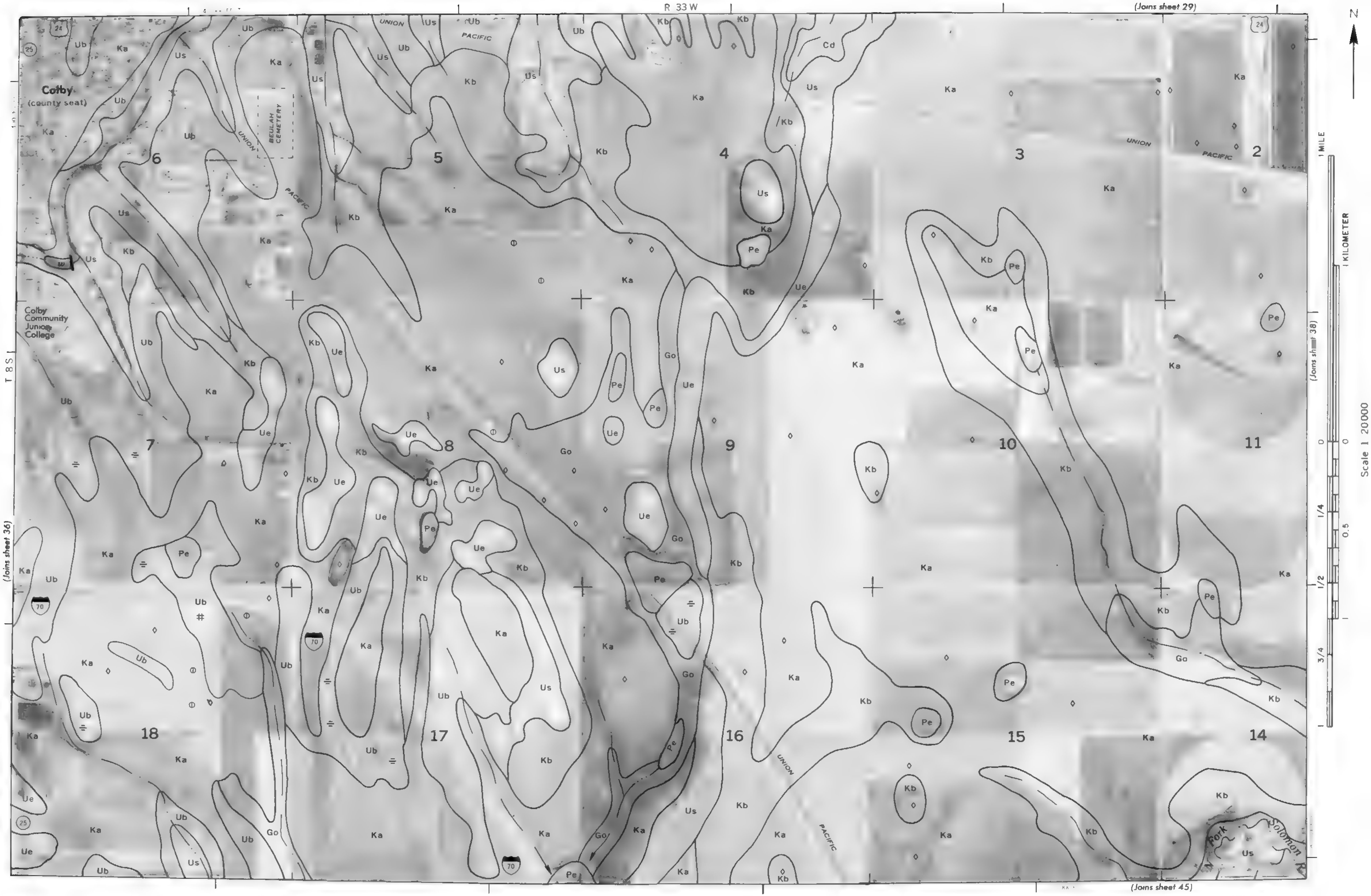

33
N
R 36 W
(Joins sheet 25)
(Joins sheet 34)
(Joins sheet 41)
T 8 S
SHERMAN COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
Brewster
Hutton Airport
CHICAGO ROCK ISLAND AND PACIFIC
Sappa Creek
South Fork
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
Ka
Kb
Ua
Ub
Us
Ue
Cd
Ha
Go
Rx
184
24
70

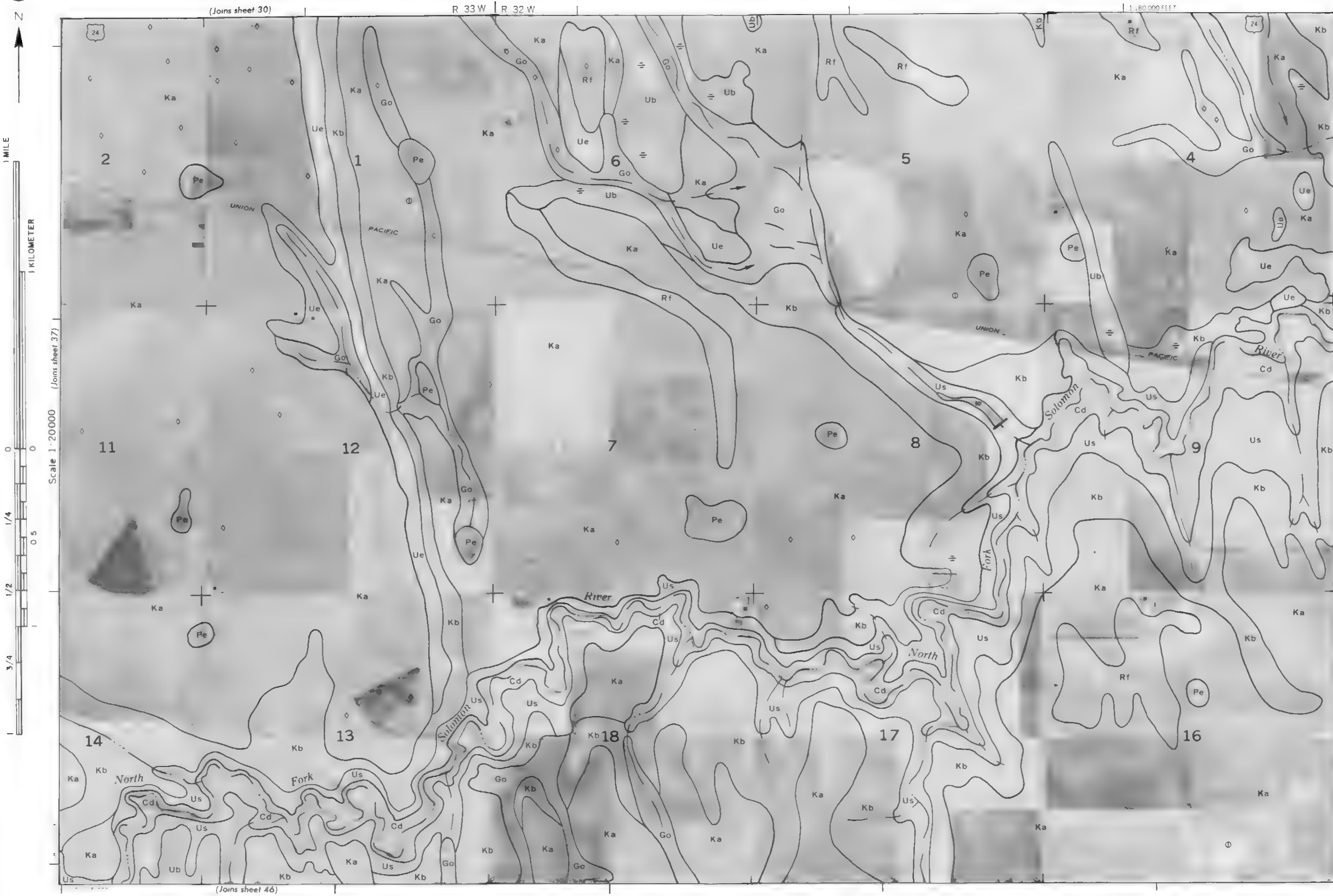

34
(Joins sheet 26)
R. 36 W. | R. 35 W.
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 42)
T 8 S
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
South Fork Sappa Creek
CHICAGO ROCK ISLAND AND PACIFIC
24
70
Ua
Ka
Kb
Ub
Us
Ha
Cd
Pe
Pa
Go
Ue
Rf
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18

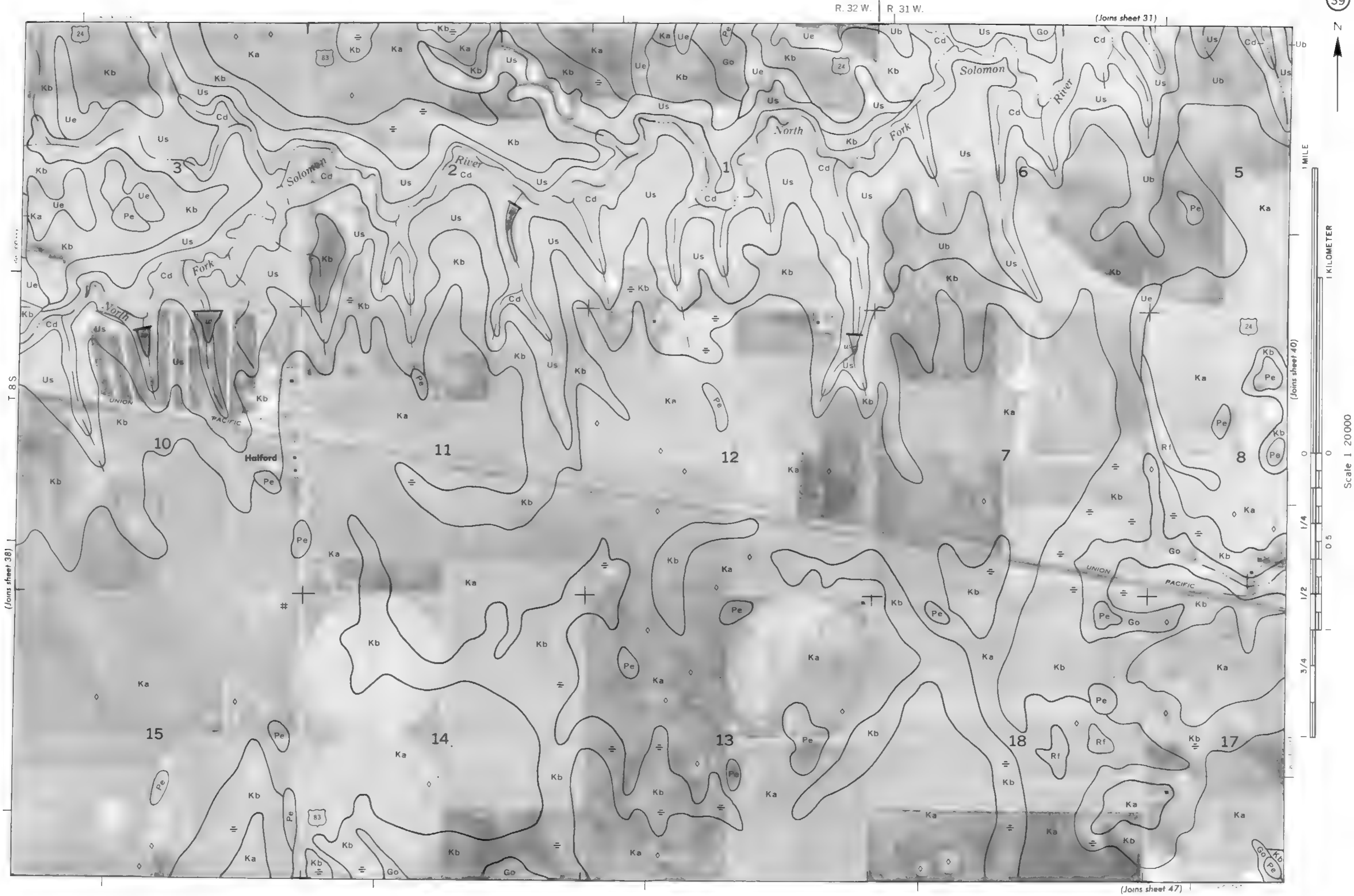

35
R 35 W | R 34 W.
(Joins sheet 27)
(Joins sheet 36)
(Joins sheet 34)
(Joins sheet 43)
T 8 S
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
390 000 FEET
Levant
CHICAGO ROCK ISLAND AND PACIFIC
Prairie Dog Creek
Creek
Dog
24
70
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
Ka
Kb
Ub
Us
Ue
Cd
Rf
Go
Pe
Ua

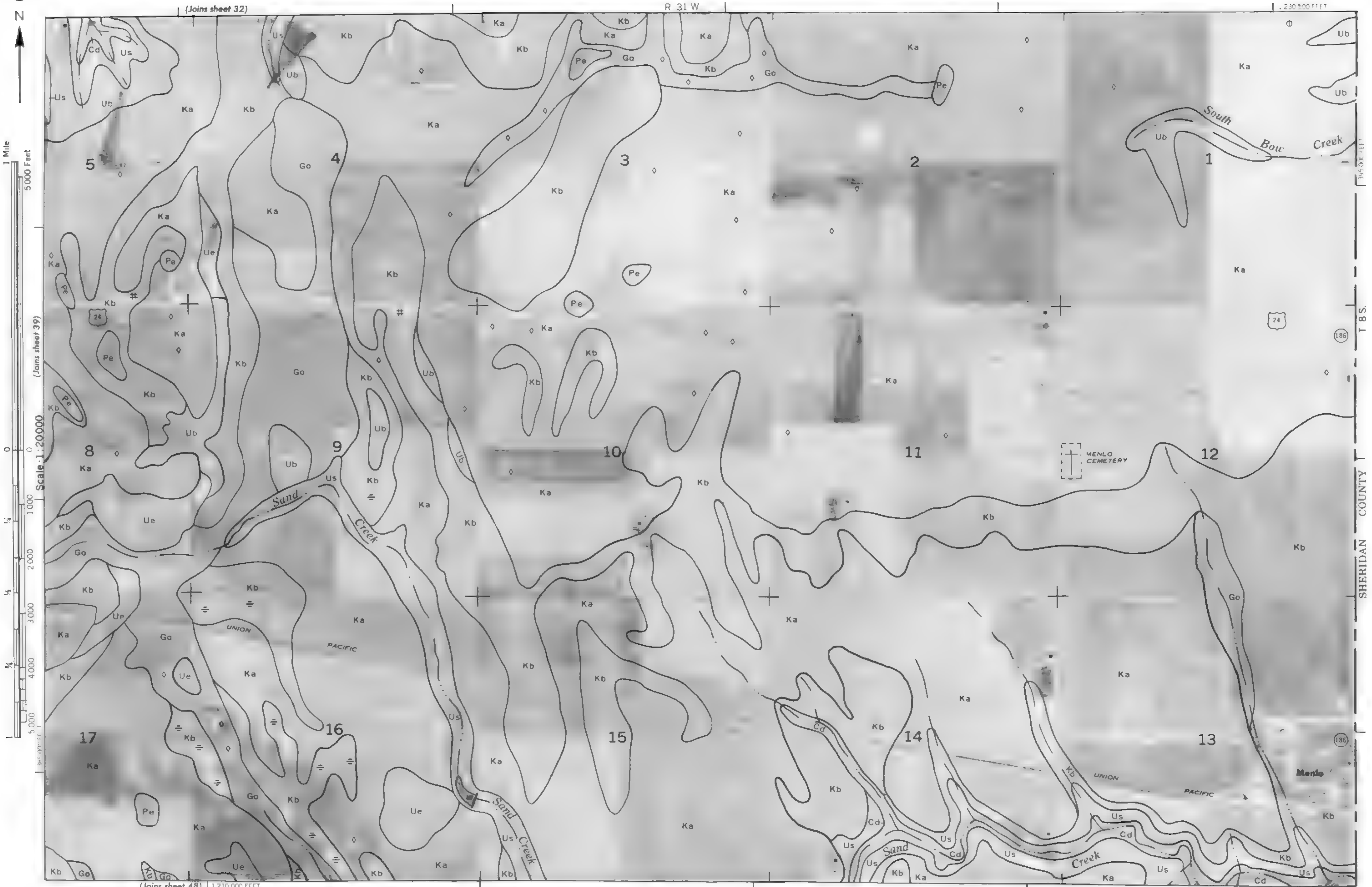
THOMAS COUNTY, KANSAS — SHEET NU■BER 36

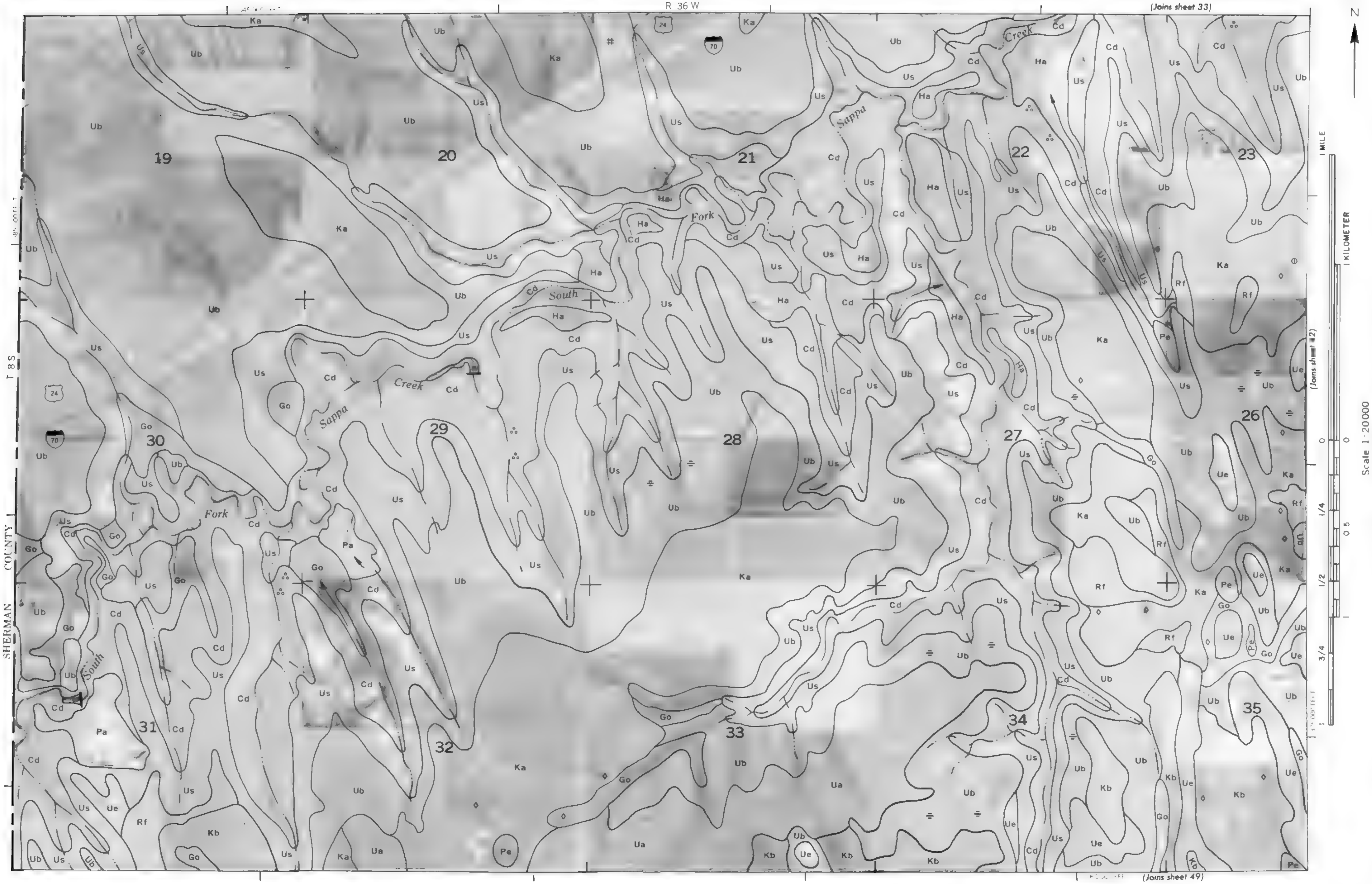


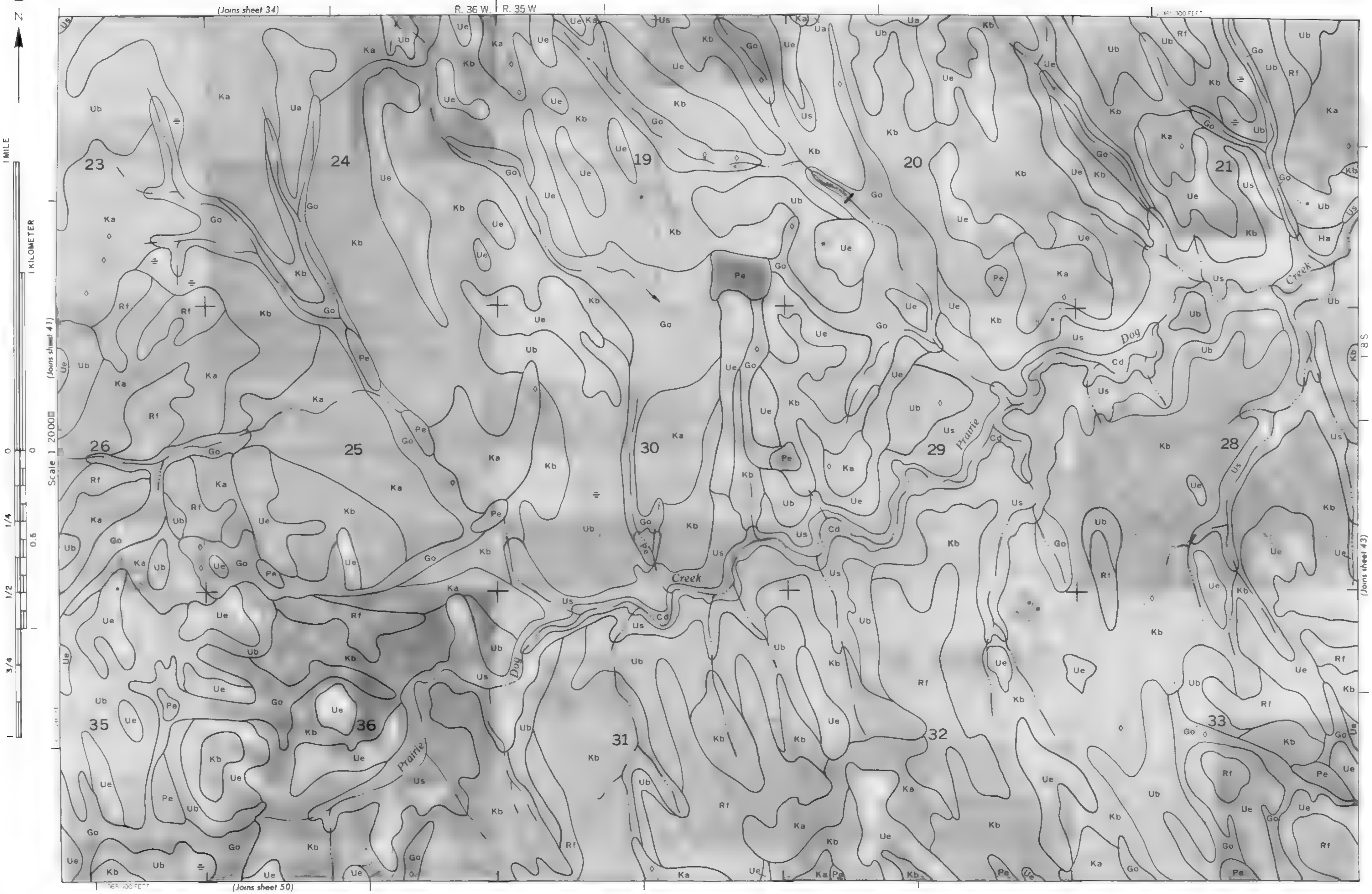

R 33 W
(Joins sheet 29)
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 45)
T 8 S
N
Colby
(county seat)
Colby Community Junior College
BEULAH CEMETERY
UNION PACIFIC
Solomon R.
Fork
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
1 MILE
1 KILOMETER
Scale 1:20000
Ka
Kb
Ub
Us
Ue
Pe
Go
Cd

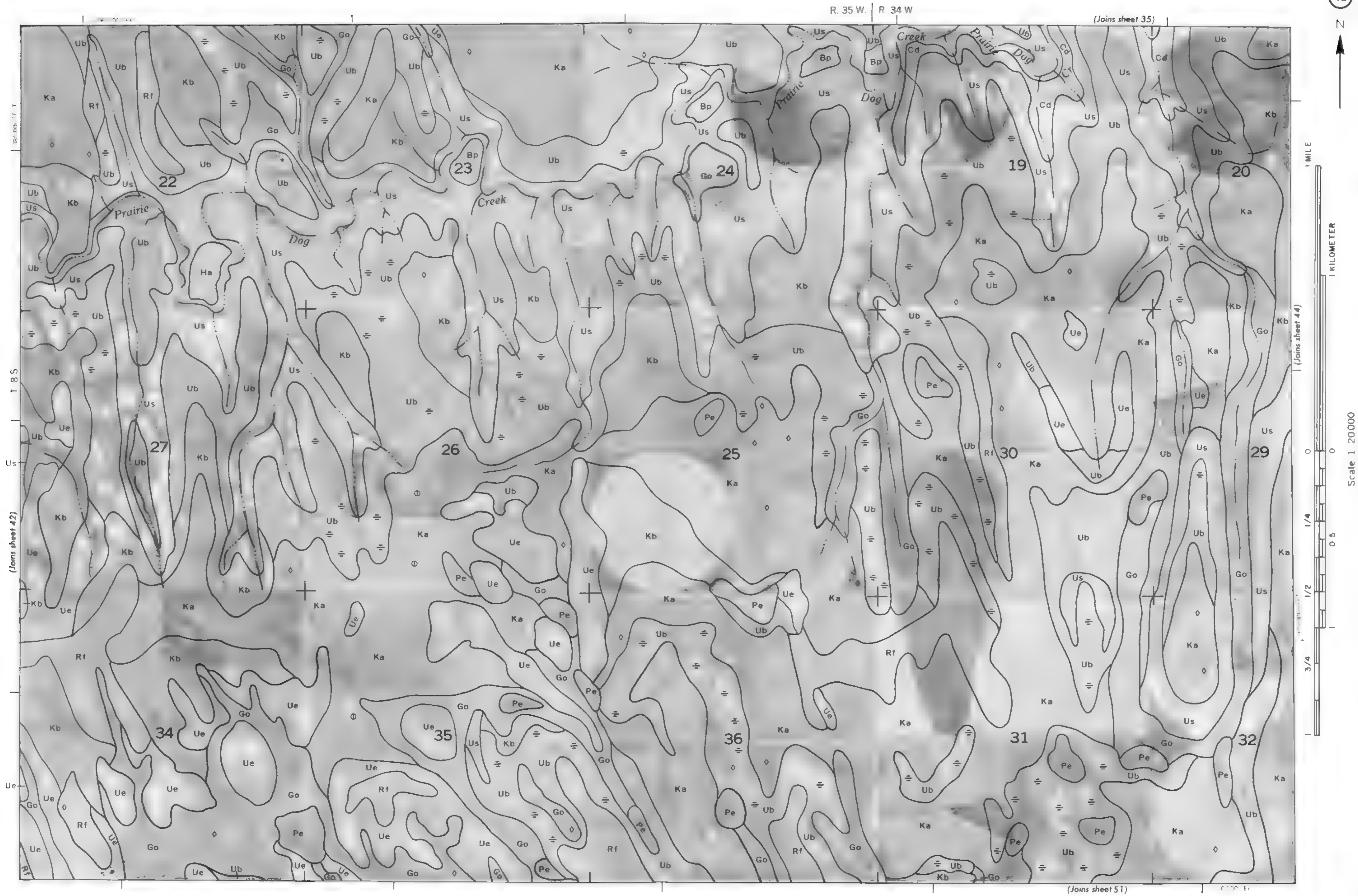

(Joins sheet 30)
R 33 W
R 32 W
1 80 000 FEET
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 46)
T 8 S
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
24
UNION
PACIFIC
UNION
PACIFIC
Solomon
River
North
Fork
Solomon
River
North
Fork
Solomon
North
Fork
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
Ka
Kb
Go
Ue
Ub
Pe
Rf
Us
Cd

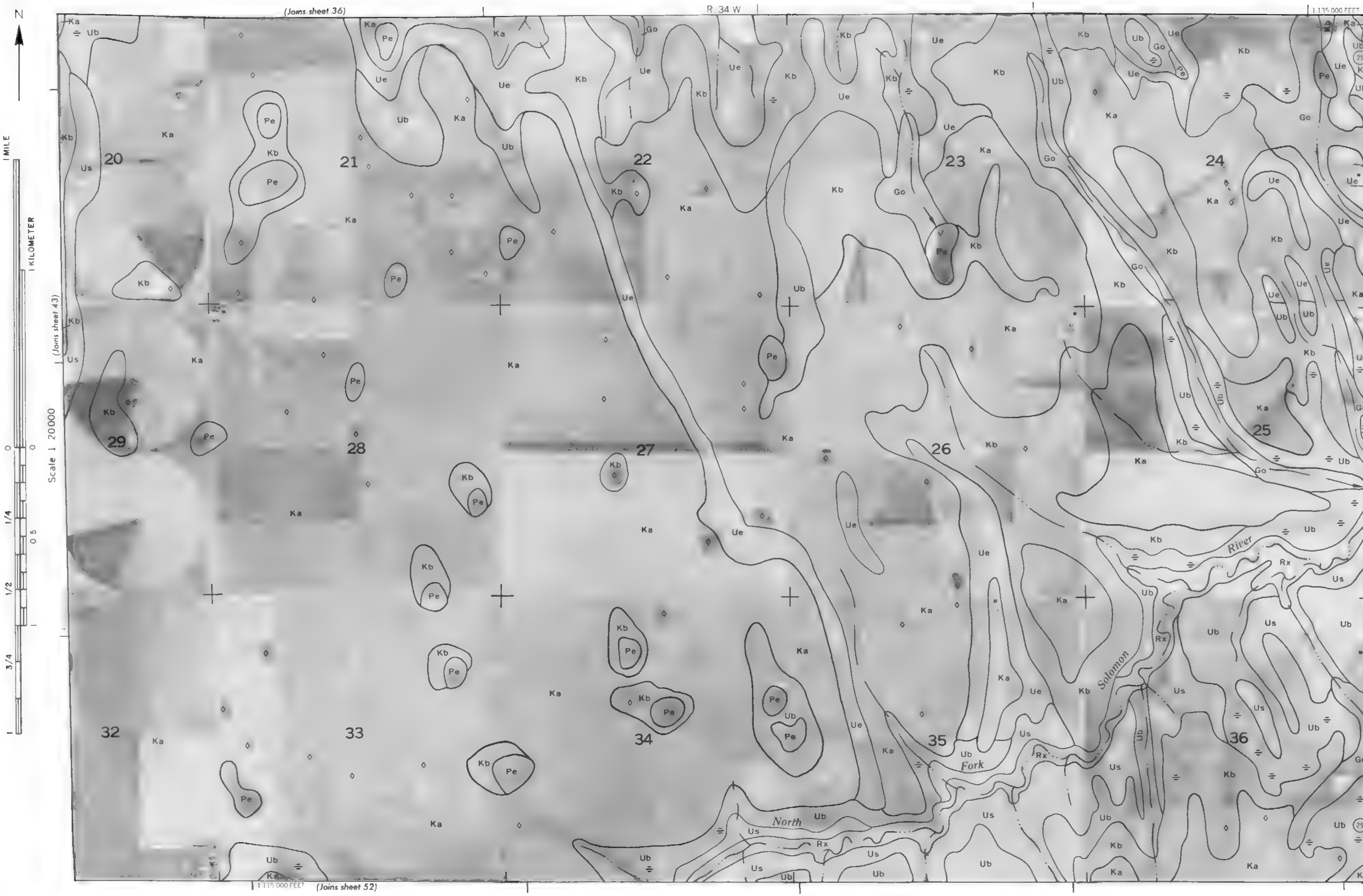

39
N
R. 32 W.
R. 31 W.
(Joins sheet 31)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 47)
T 8 S
North Fork Solomon River
Solomon
River
North
Fork
UNION PACIFIC
Halford
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
0.5
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
Ka
Kb
Ub
Ue
Us
Cd
Go
Pe
Rf
24
83


(Joins sheet 32)
R. 31 W.
(Joins sheet 39)
(Joins sheet 48)
N
1 Mile
5000 Feet
Scale 1:20000
South Bow Creek
Sand Creek
UNION PACIFIC
MENLO CEMETERY
Menlo
SHERIDAN COUNTY
T. 8 S.
24
186
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

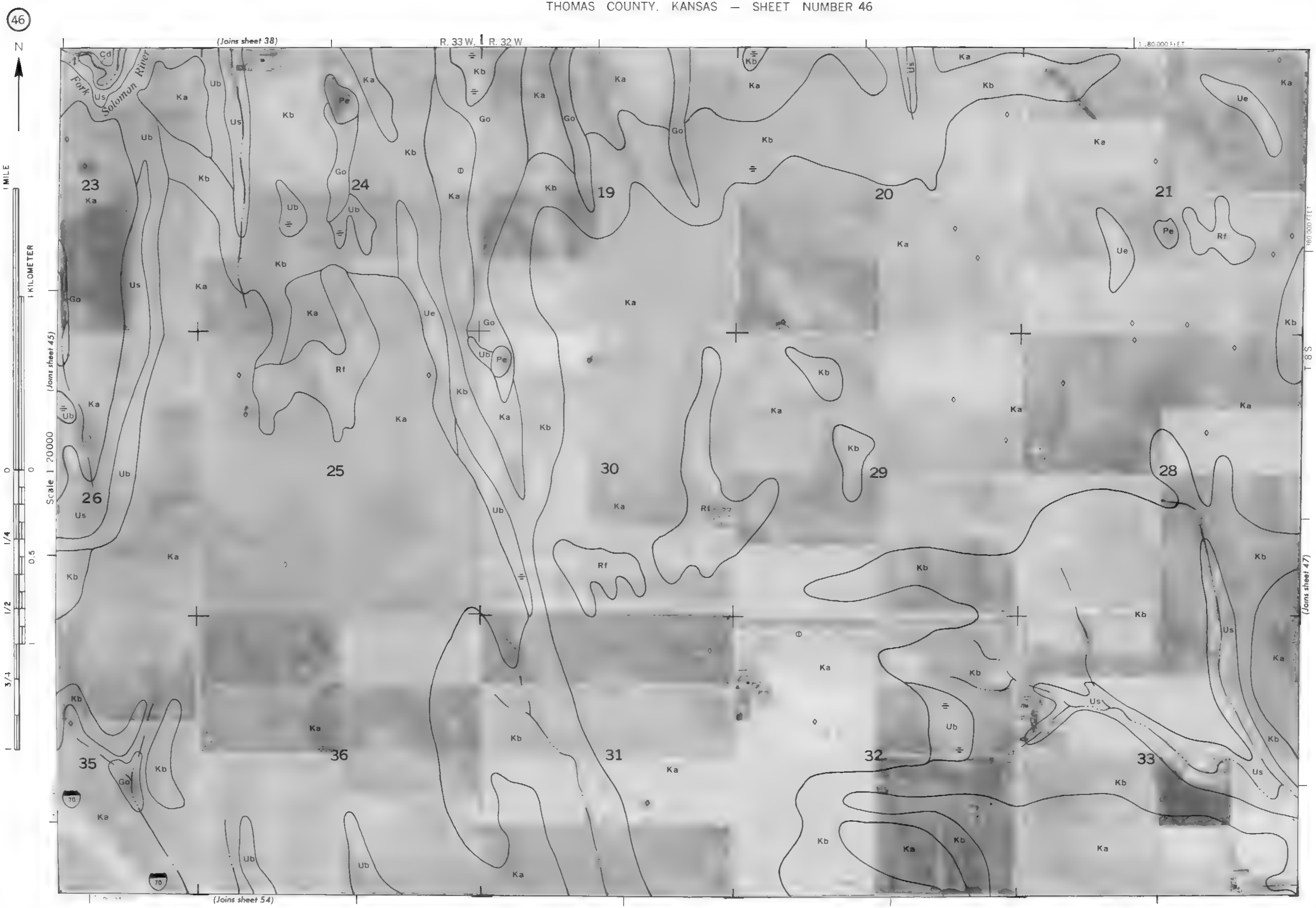

41
N
R 36 W
(Joins sheet 33)
(Joins sheet 42)
(Joins sheet 49)
T 8 S
SHERMAN COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
South Fork
Sappa Creek
24
70
Ub
Us
Ka
Kb
Cd
Ha
Go
Pa
Pe
Rf
Ue
Ua

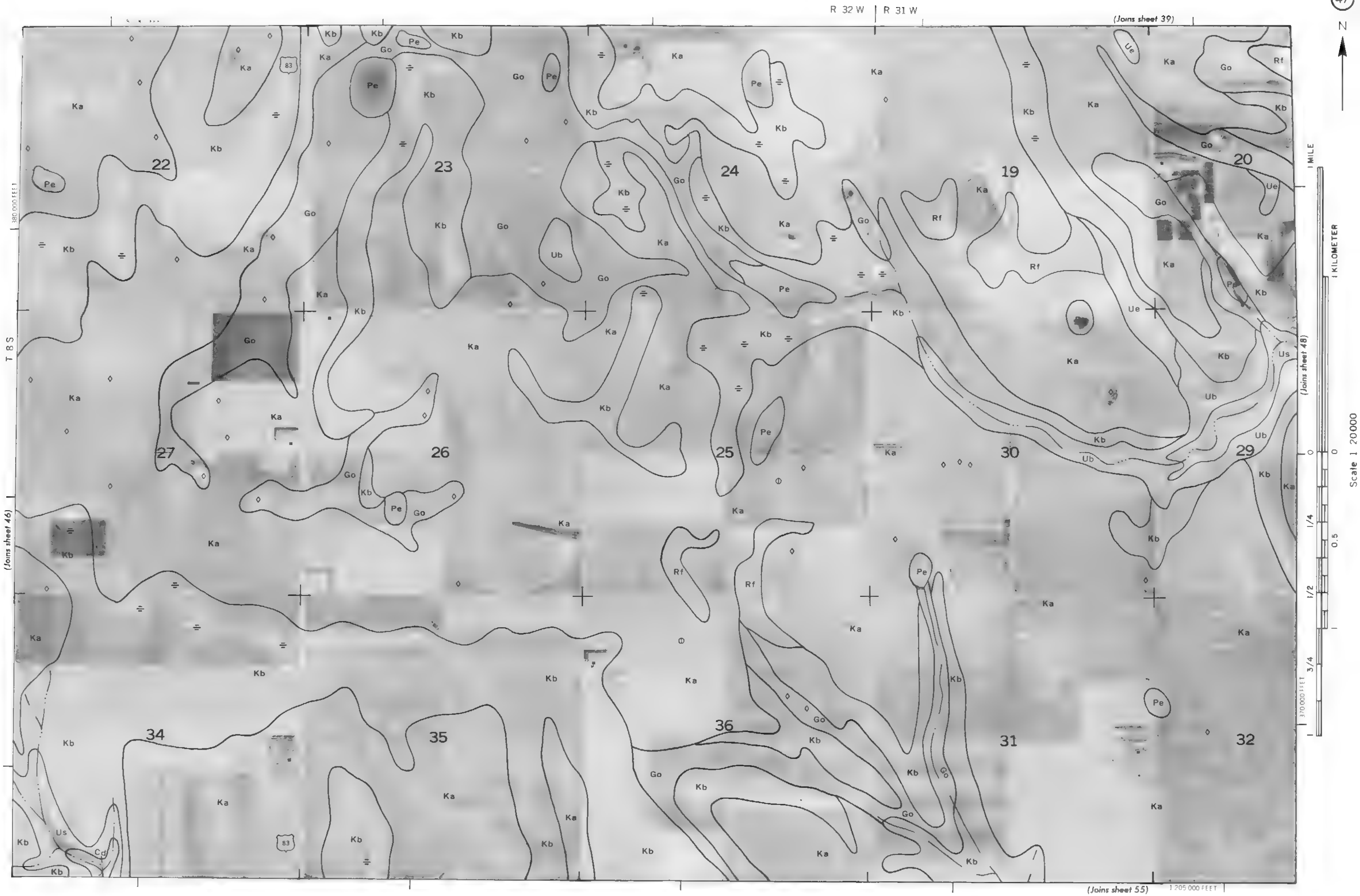

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 34)
R. 36 W.
R. 35 W.
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 50)
T 8 S
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
Prairie
Dog
Creek
Prairie
Dog
Creek
Prairie
Dog
Creek
Ka
Kb
Ub
Ue
Ua
Us
Go
Rf
Pe
Cd
Ha

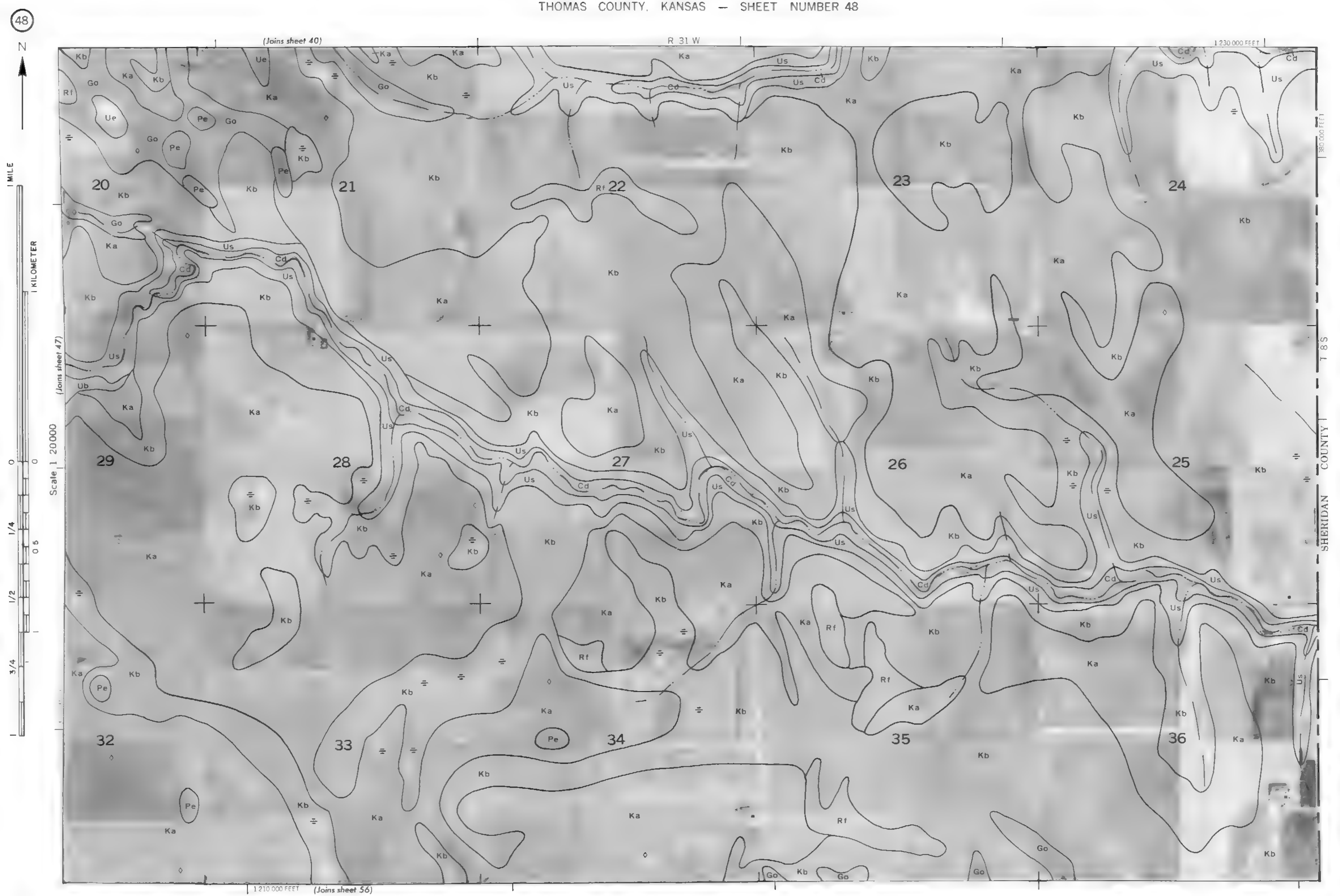

43
N
R. 35 W.
R. 34 W.
(Joins sheet 35)
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 51)
T 8 S
Prairie
Dog
Creek
Prairie Dog Creek
Prairie Dog Cr
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36
1 MILE
1 KILOMETER
Scale 1 20000

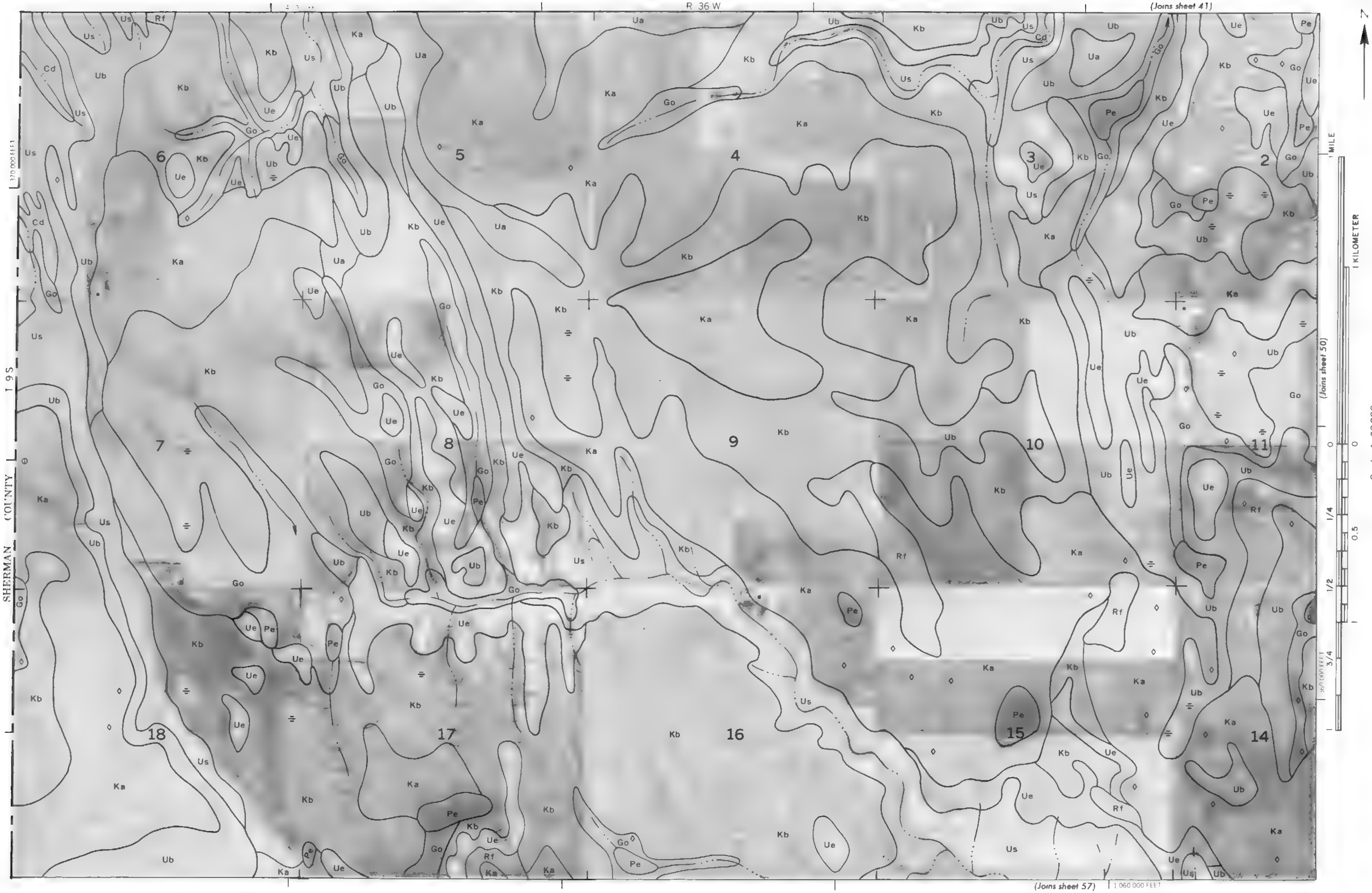

N
1 MILE
1 KILOMETER
Scale 1 20000
0
1/4
1/2
3/4
0
0.5
(Joins sheet 36)
R 34 W
1 135 000 FEET
(Joins sheet 43)
(Joins sheet 45)
T 8 S.
(Joins sheet 52)
1 115 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
North
Fork
Solomon
River
25
Ka
Kb
Pe
Ub
Ue
Us
Go
Rx

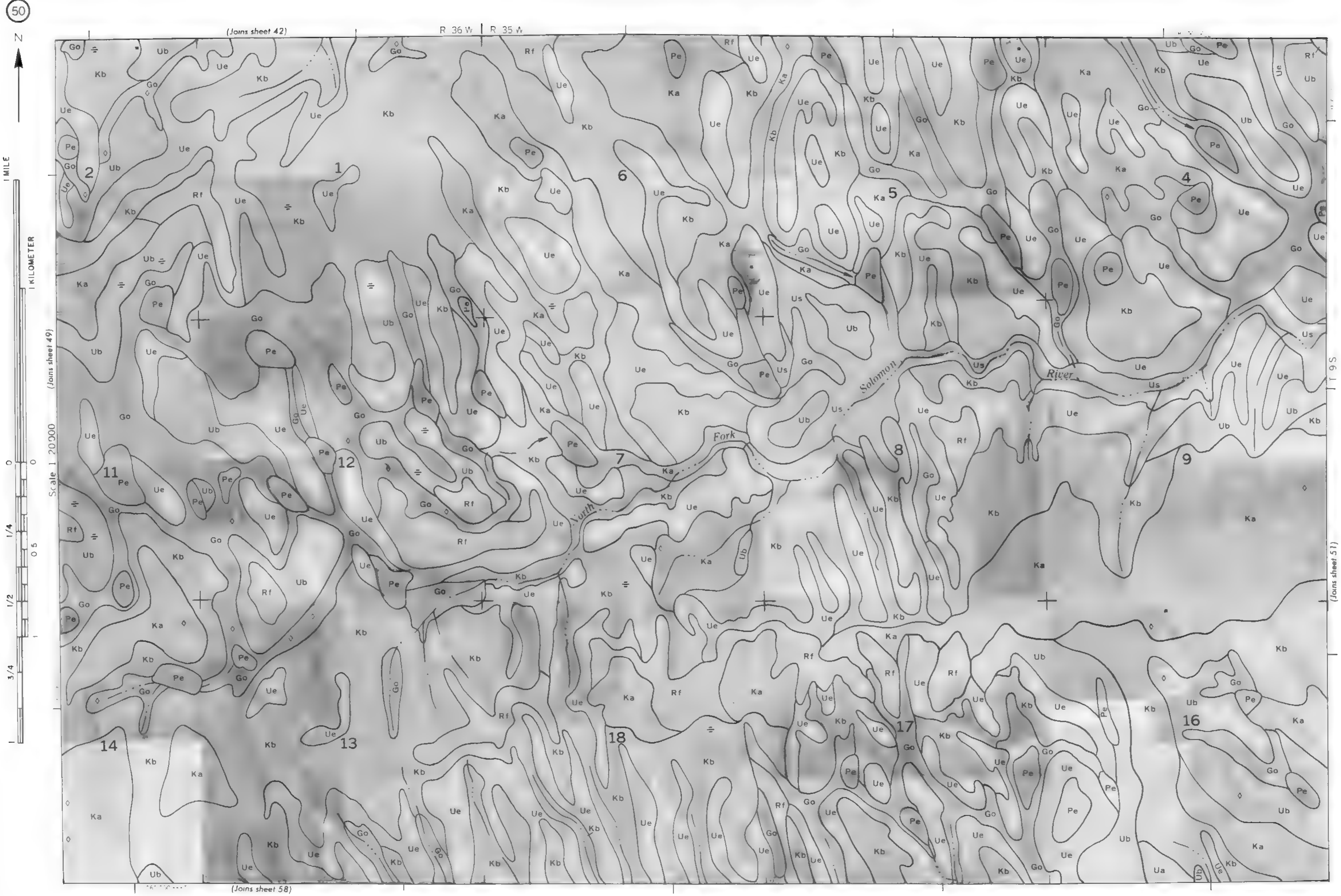

45
N
R 33 W
(Joins sheet 37)
(Joins sheet 44)
(Joins sheet 36)
(Joins sheet 53)
T 8 S
North Fork Solomon River
Altair
UNION PACIFIC
70
water
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
1 MILE
1/4
1/2
3/4
0
1 KILOMETER
0.5
Scale 1:20000


46
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 38)
R. 33 W.
R. 32 W.
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 54)
T 8 S
Fork Solomon River
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
Cd
Us
Ub
Ue
Ka
Kb
Go
Pe
Rf
70

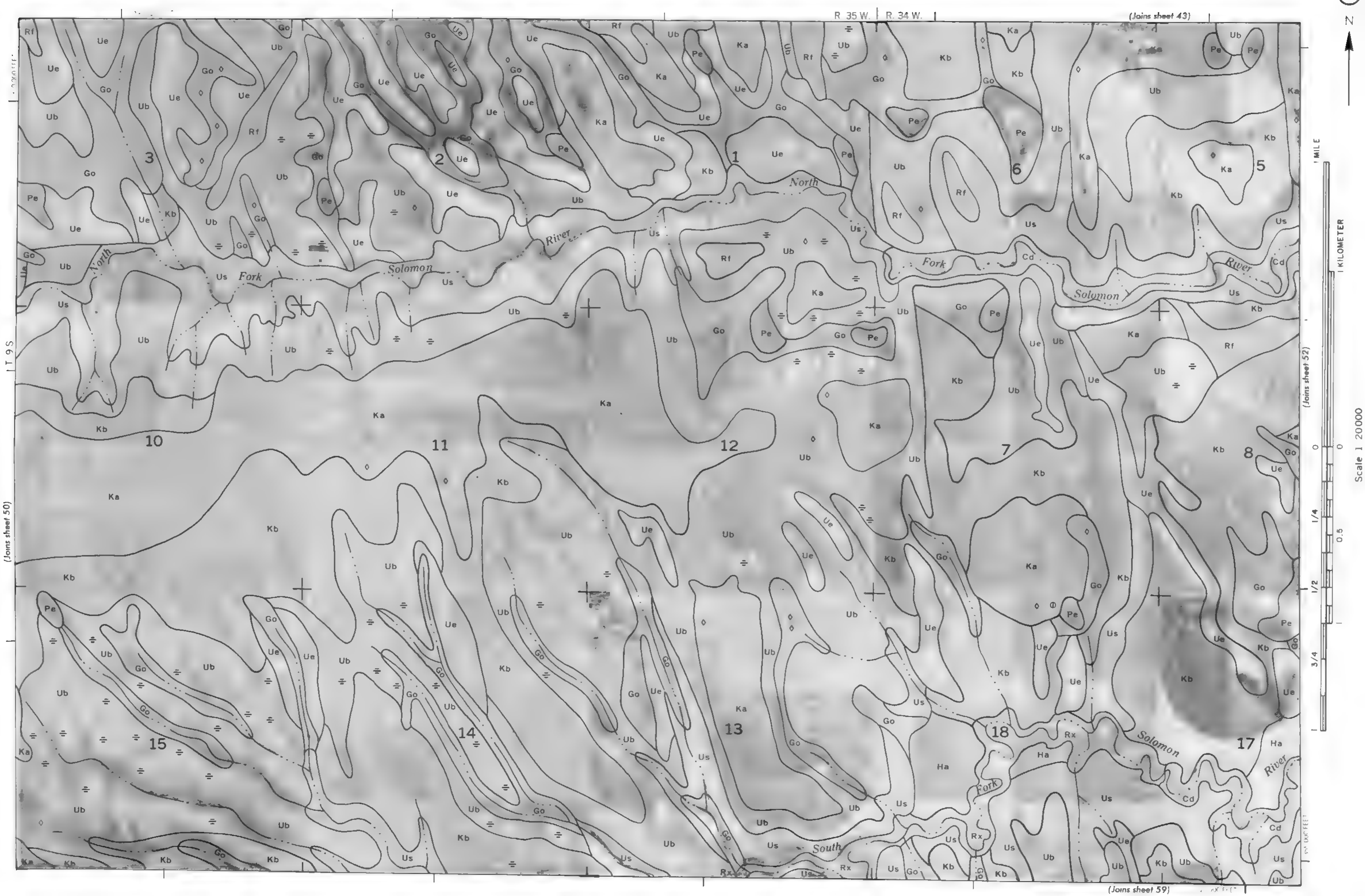

47
R 32 W
R 31 W
(Joins sheet 39)
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 55)
T 8 S
N
1 MILE
1 KILOMETER
Scale 1 20000
0
1/4
1/2
3/4
0.5
1
380 000 FEET
370 000 FEET
1 205 000 FEET
83
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
Ka
Kb
Go
Pe
Ub
Ue
Us
Rf
Cd

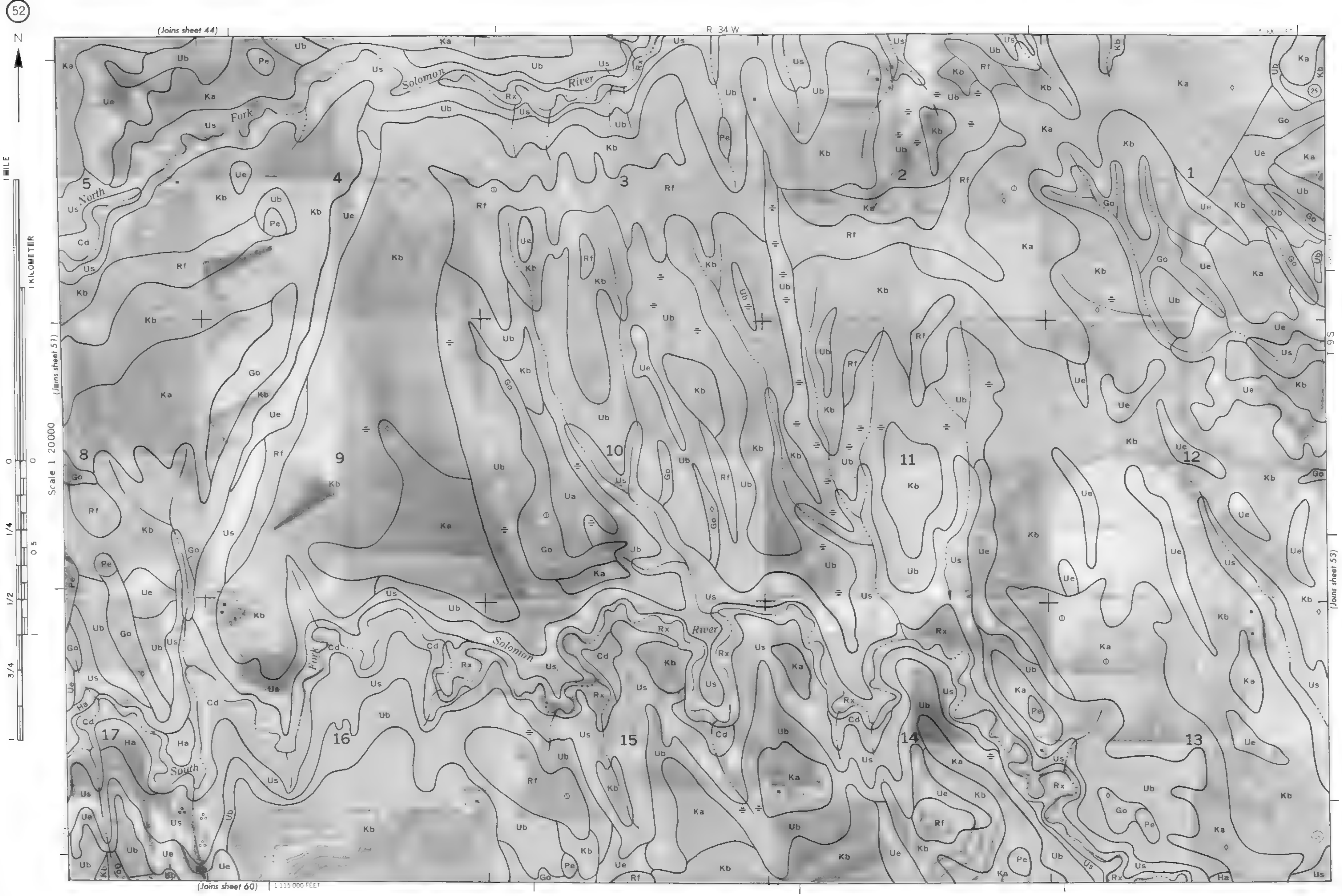

48
N
(Joins sheet 40)
R 31 W
1 230 000 FEET
380 000 FEET
(Joins sheet 47)
(Joins sheet 56)
1 210 000 FEET
T 8 S
SHERIDAN COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
20
21
22
23
24
29
28
27
26
25
32
33
34
35
36
Kb
Ka
Ue
Go
Rf
Pe
Us
Cd
Ub

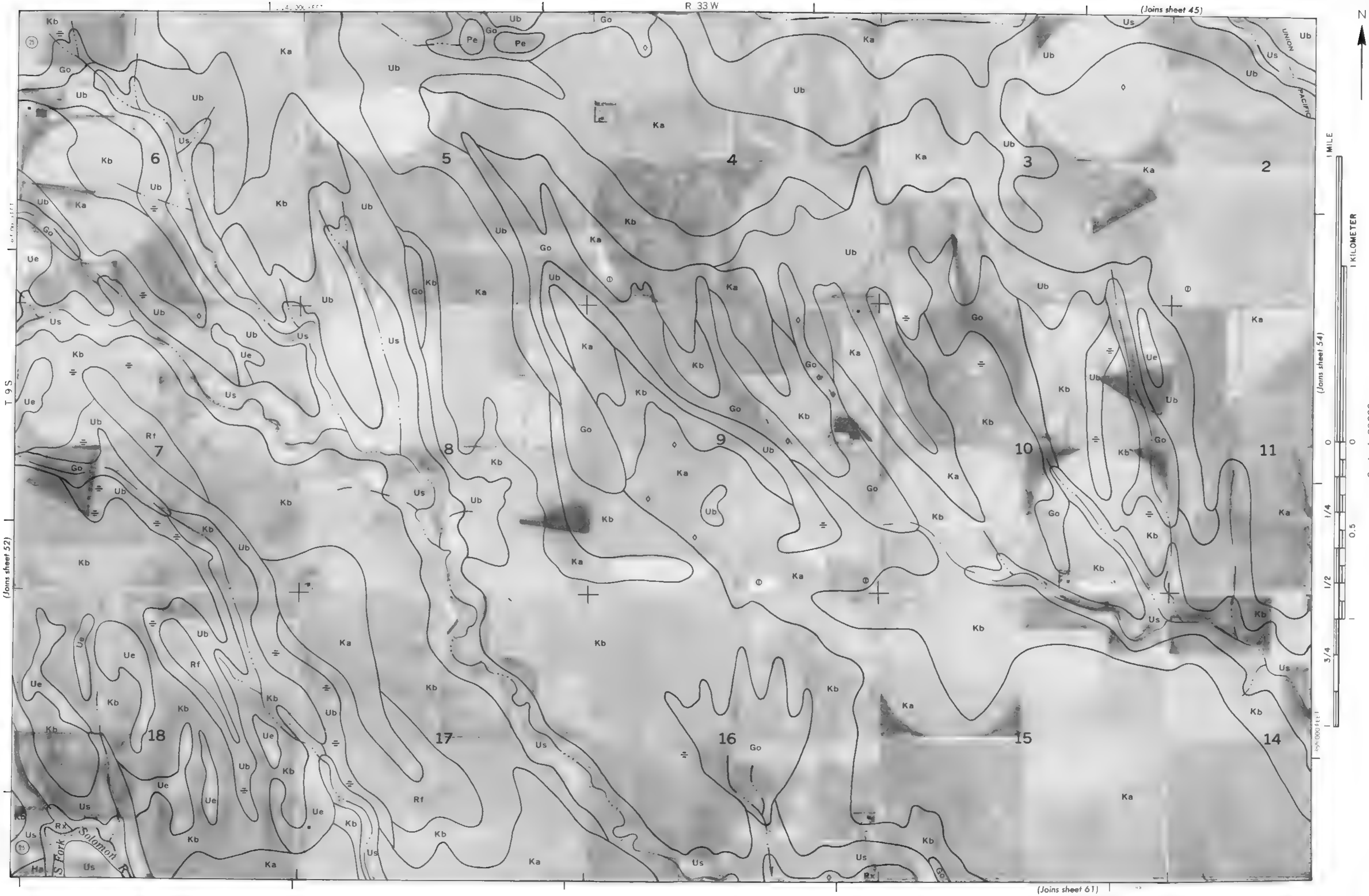

R 36 W
(Joins sheet 41)
(Joins sheet 50)
(Joins sheet 57)
T 9 S
SHERMAN COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
1 060 000 FEET
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18

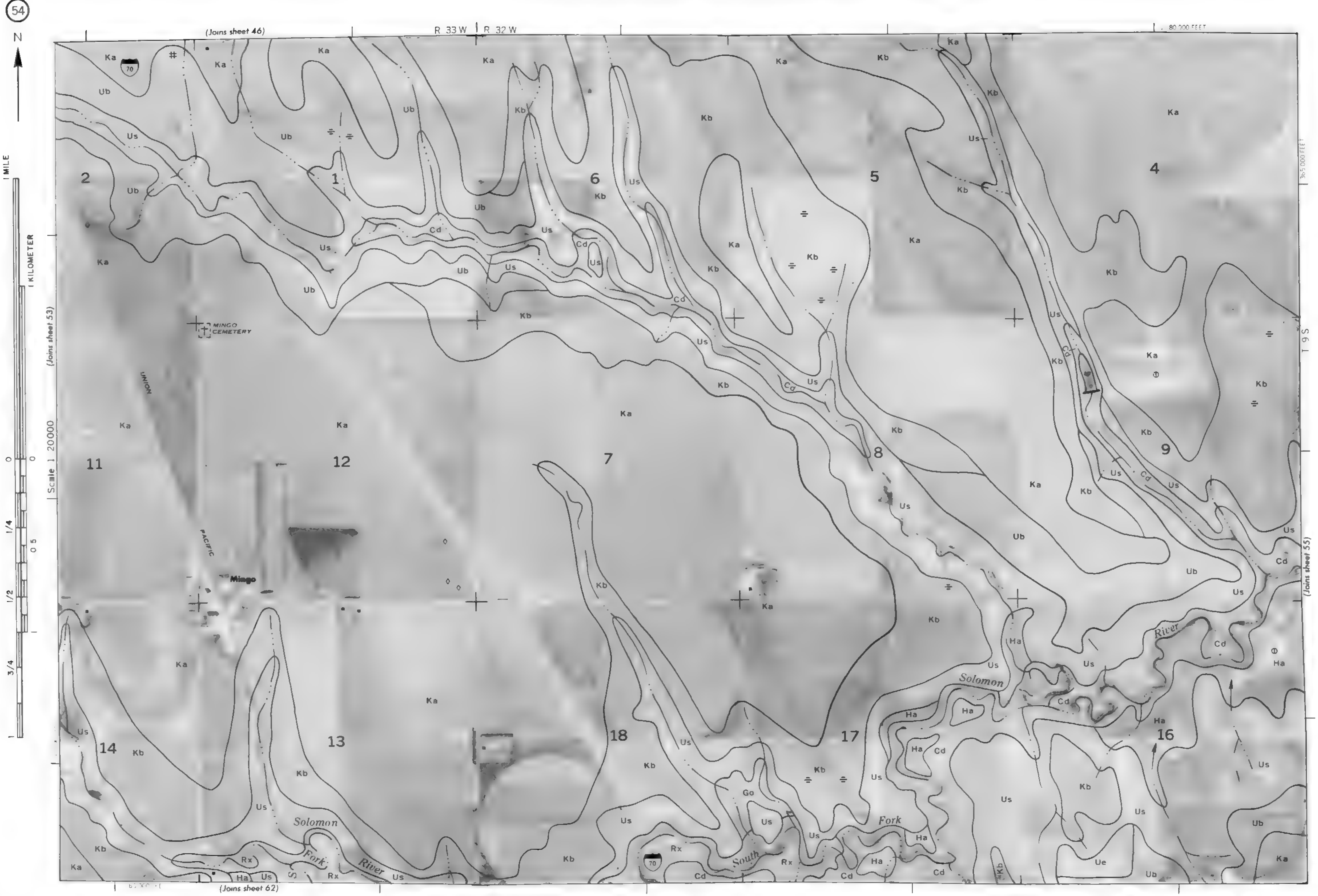

50
N
(Joins sheet 42)
R 36 W | R 35 W
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 58)
T 9 S
Solomon River
North Fork
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

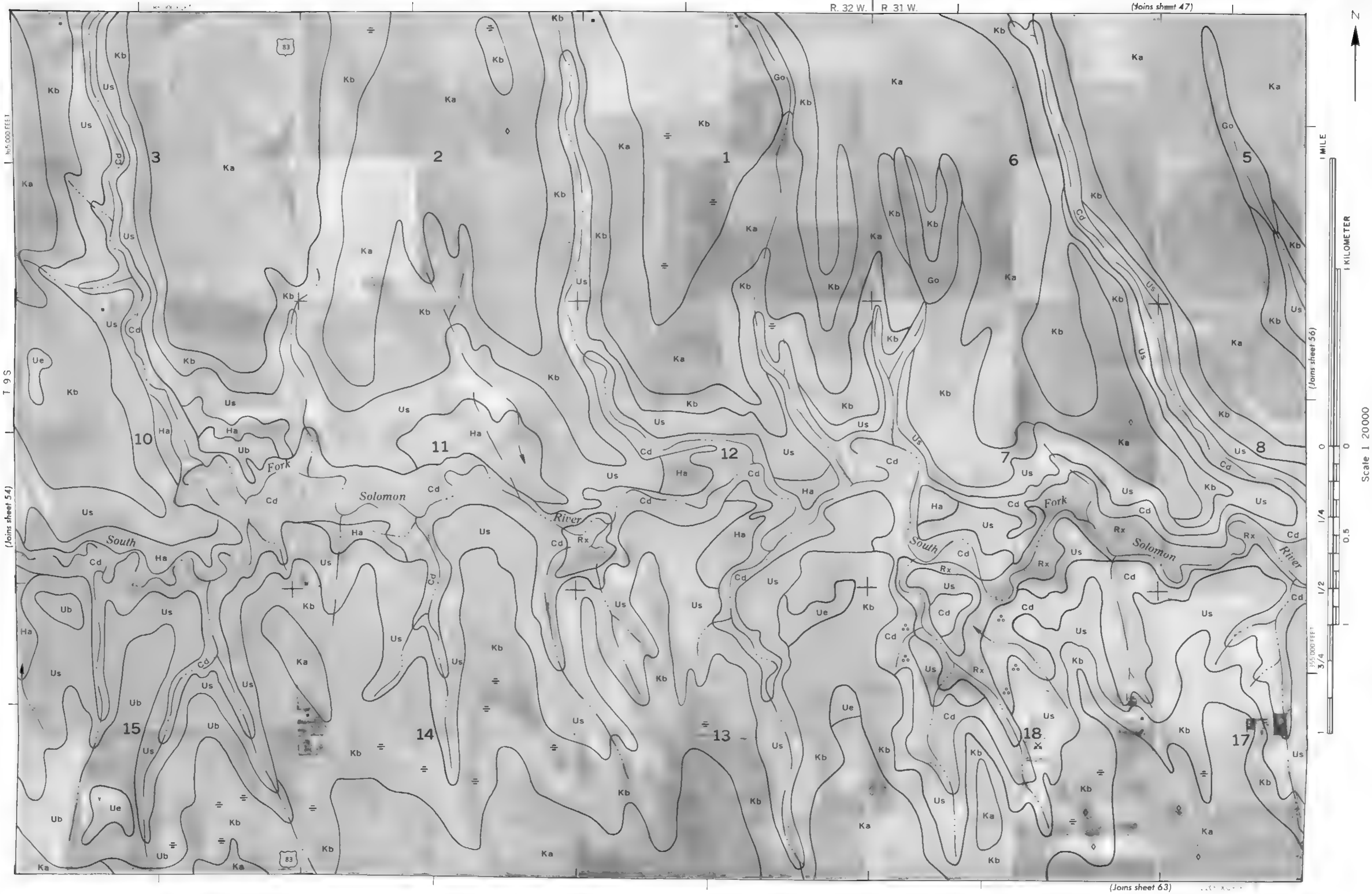
51

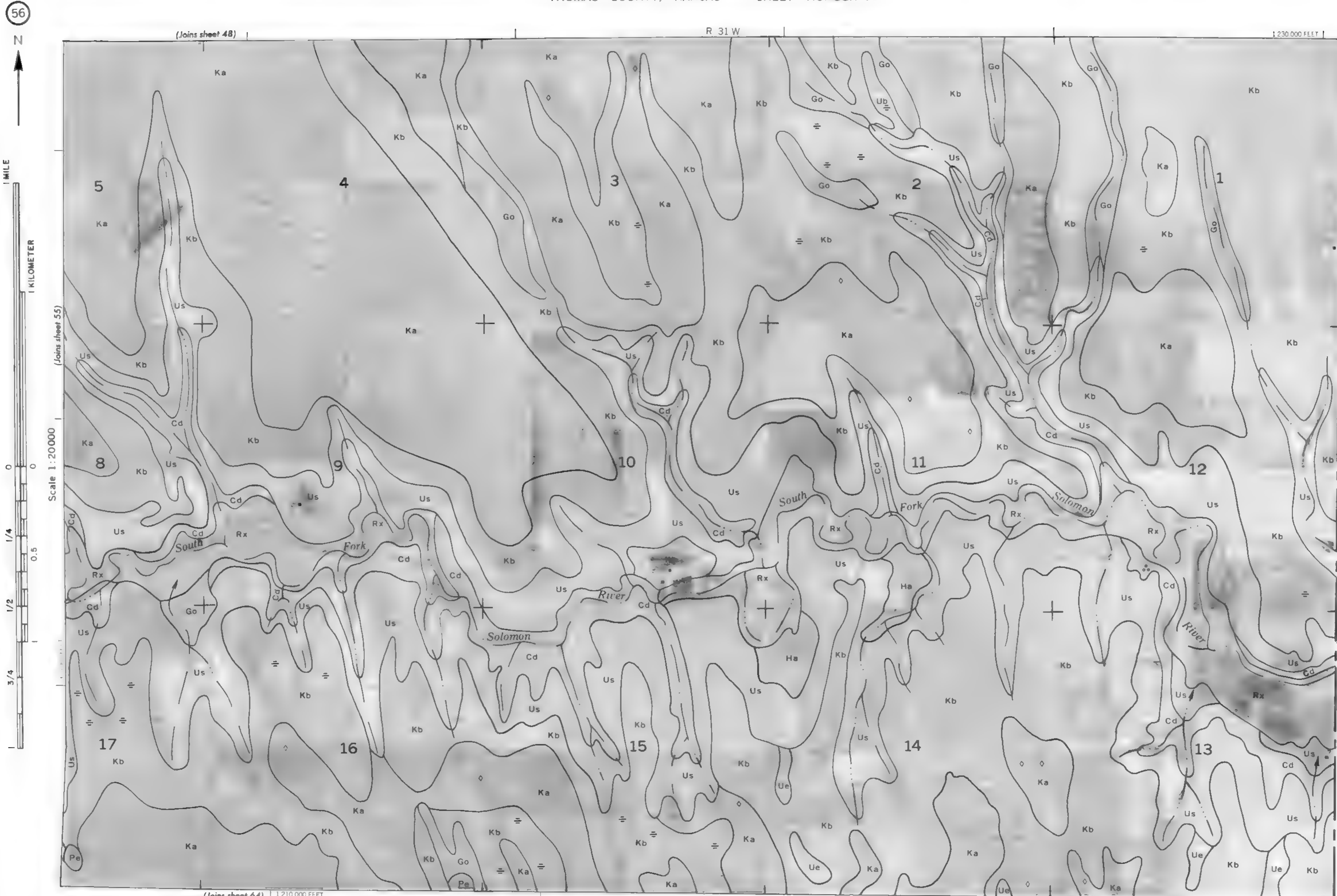

R. 35 W.
R. 34 W.
(Joins sheet 43)
(Joins sheet 50)
(Joins sheet 52)
(Joins sheet 59)
T 9 S
N
North Fork Solomon River
South Fork Solomon River
Solomon River
1 MILE
1 KILOMETER
Scale 1:20000


52
N
1 MILE
1 KILOMETER
Scale 1 20000
0
1/4
1/2
3/4
0.5
(Joins sheet 44)
R 34 W
T 9 S
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 60)
1 115 000 FEET
North Fork
Solomon River
Solomon River
Fork
South
25

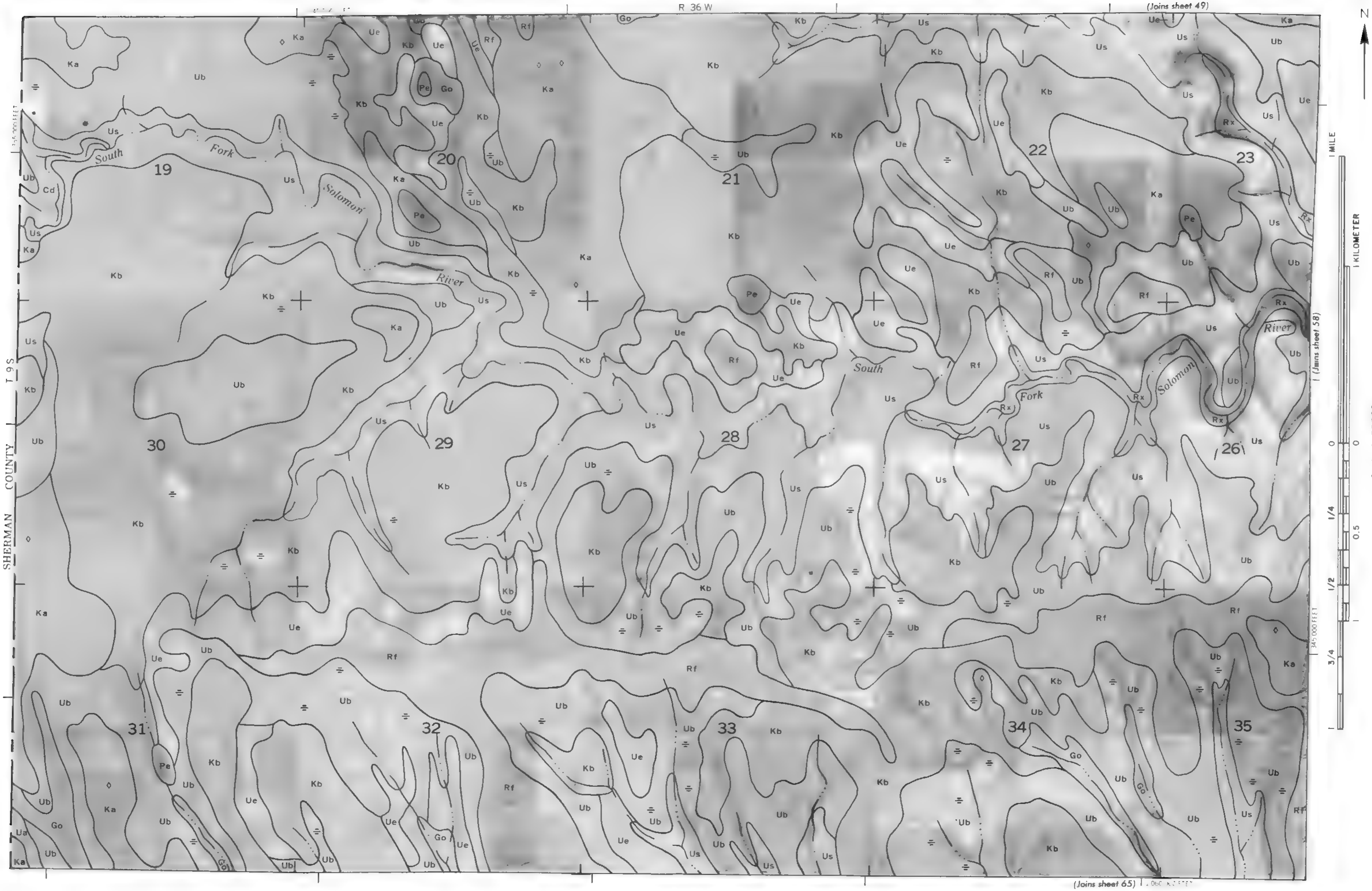

N
R 33 W
T 9 S
(Joins sheet 45)
(Joins sheet 54)
(Joins sheet 61)
(Joins sheet 52)
UNION PACIFIC
S. Fork Solomon R.
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
Ka
Kb
Ub
Us
Ue
Go
Pe
Rf
Rx
Ha


54
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 46)
R 33 W
R 32 W
80 000 FEET
365 000 FEET
T 9 S
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 62)
MINGO CEMETERY
UNION
PACIFIC
Mingo
Solomon River
Solomon Fork River
South Fork
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
Ka
Kb
Ub
Us
Cd
Ha
Go
Rx
Ue
70

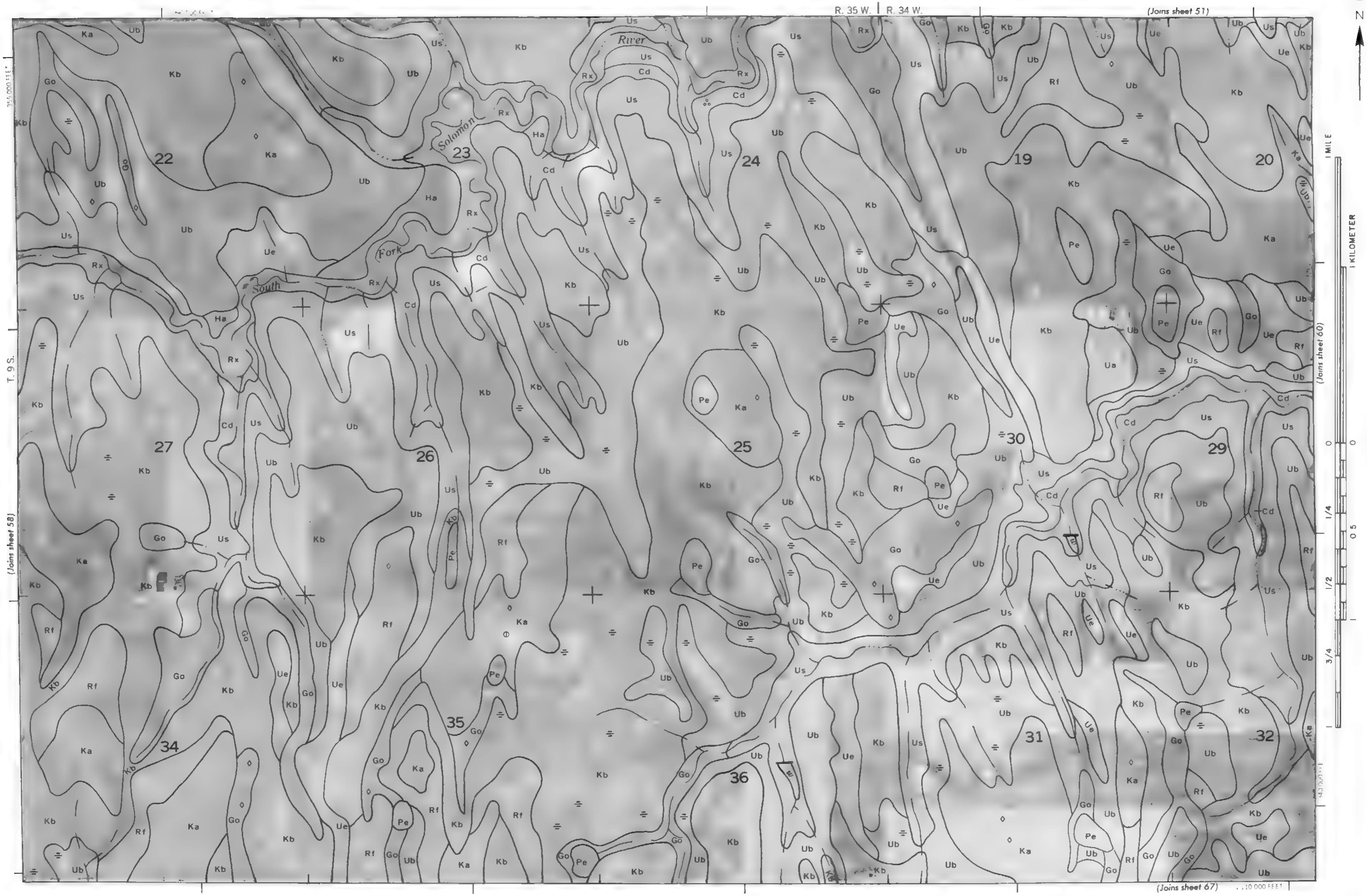

R. 32 W.
R. 31 W.
(Joins sheet 47)
(Joins sheet 54)
(Joins sheet 56)
(Joins sheet 63)
T. 9 S.
N
1 MILE
1 KILOMETER
Scale 1 20000
83
South Fork Solomon River
Ka
Kb
Us
Cd
Ha
Ub
Ue
Go
Rx
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18

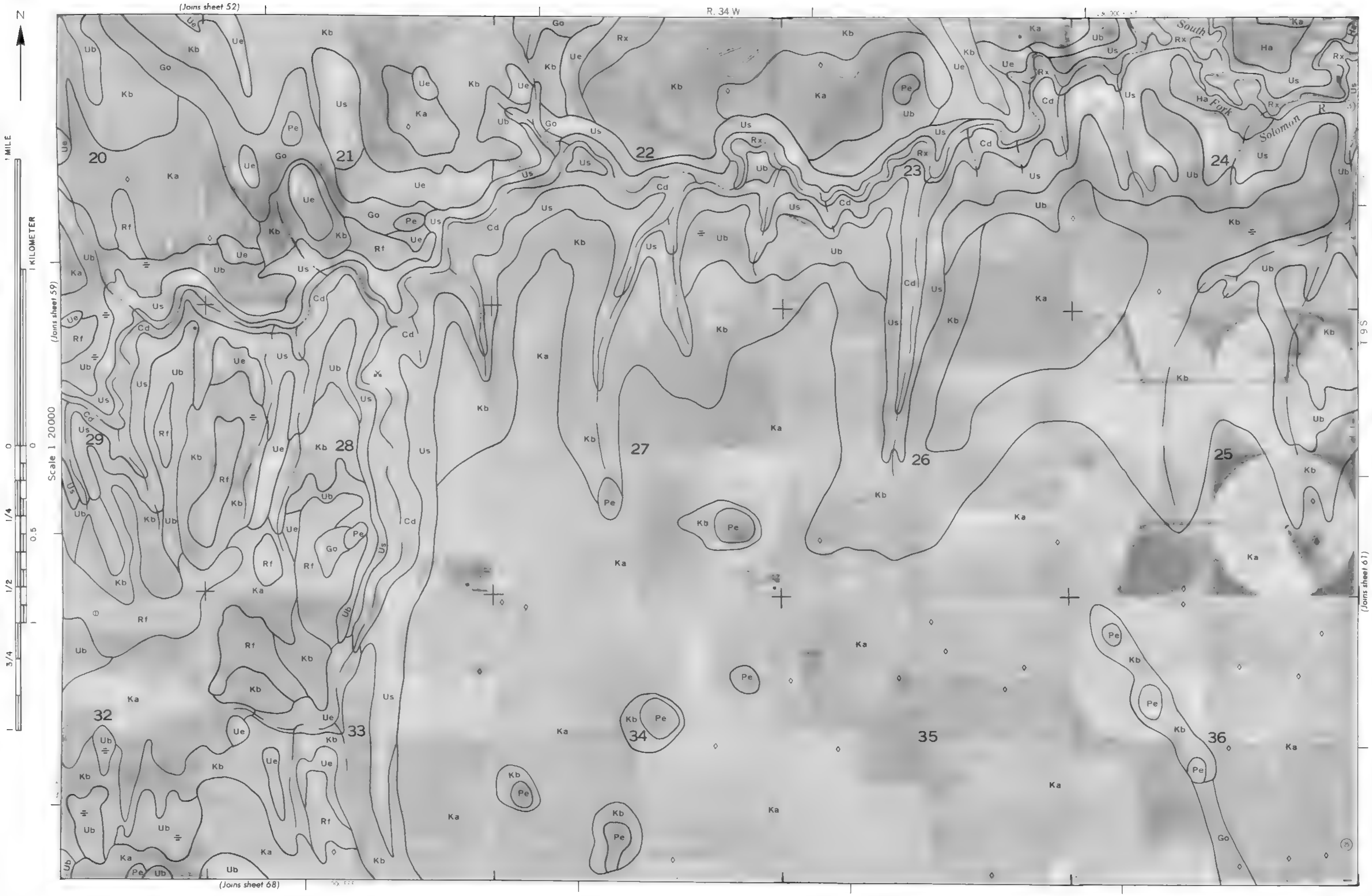

56
N
(Joins sheet 48)
R 31 W
1 230 000 FEET
(Joins sheet 55)
(Joins sheet 64)
1 210 000 FEET
T 9 S
SHERIDAN COUNTY
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
South Fork Solomon River
South Fork Solomon River
Solomon River
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

57

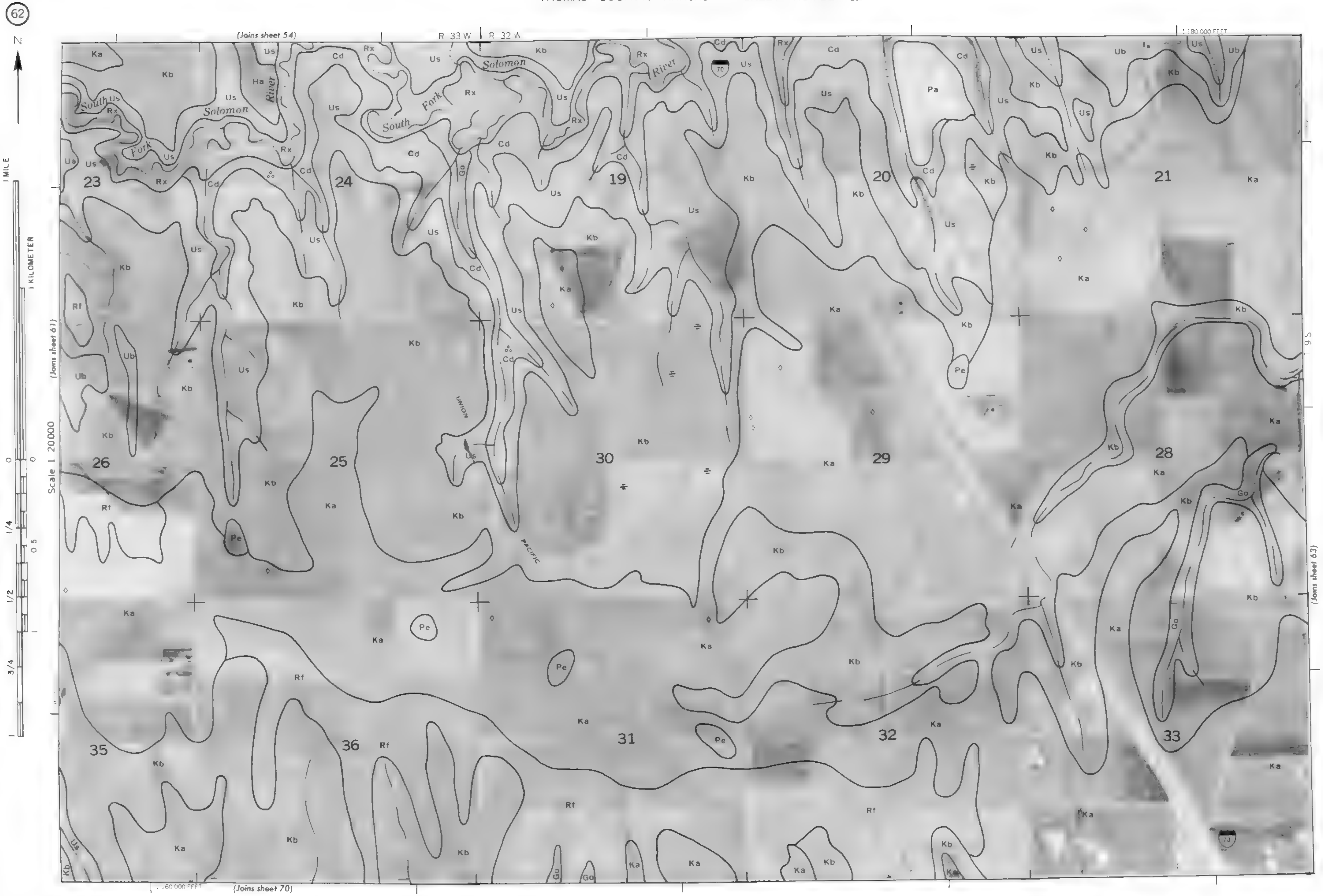

R 36 W
(Joins sheet 49)
(Joins sheet 58)
(Joins sheet 65)
T 9 S
SHERMAN COUNTY
South Fork Solomon River
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

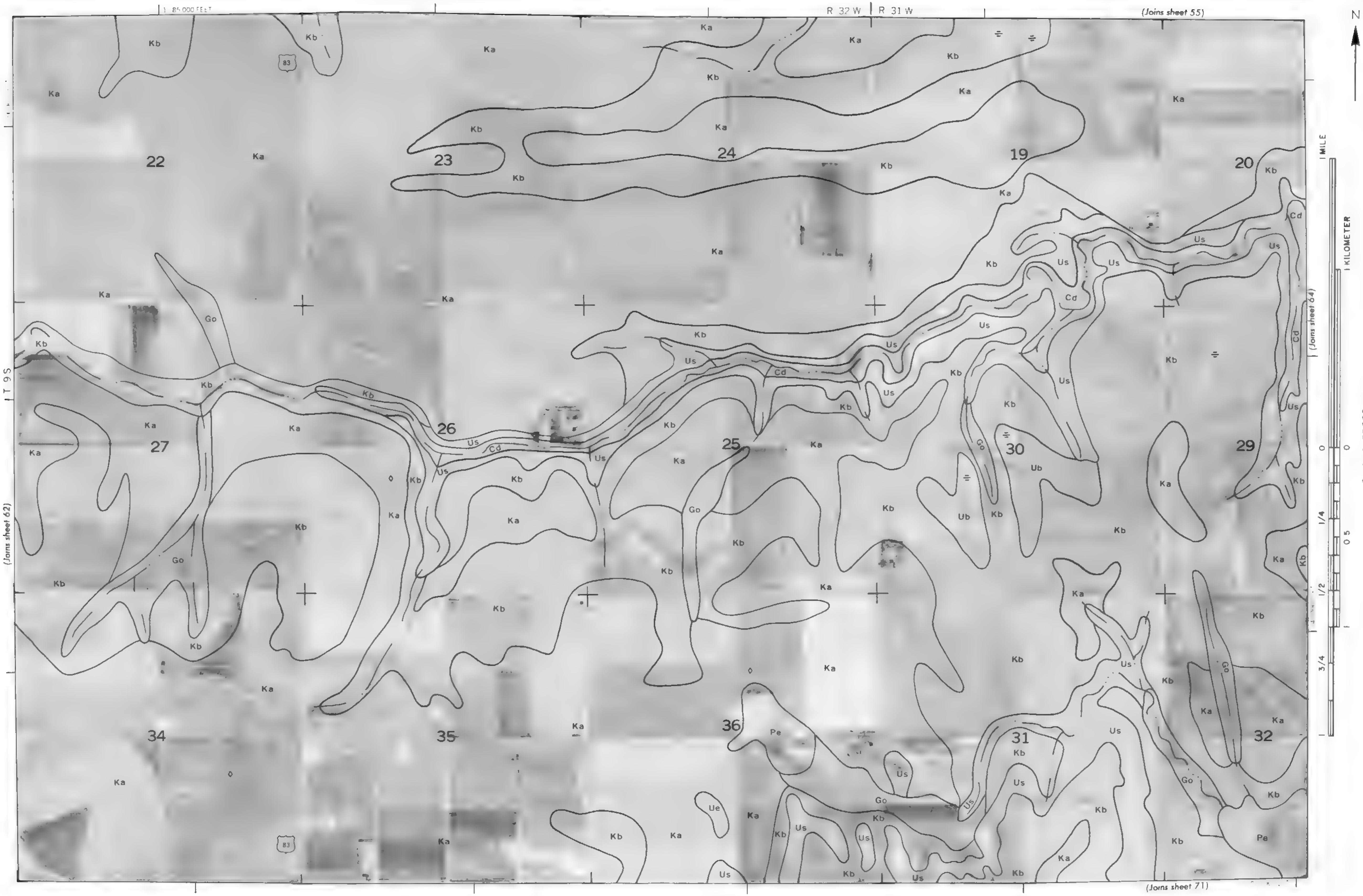

58
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 50)
R 36 W
R 35 W
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 66)
T 9 S
South Fork Solomon River
South Fork Solomon River
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

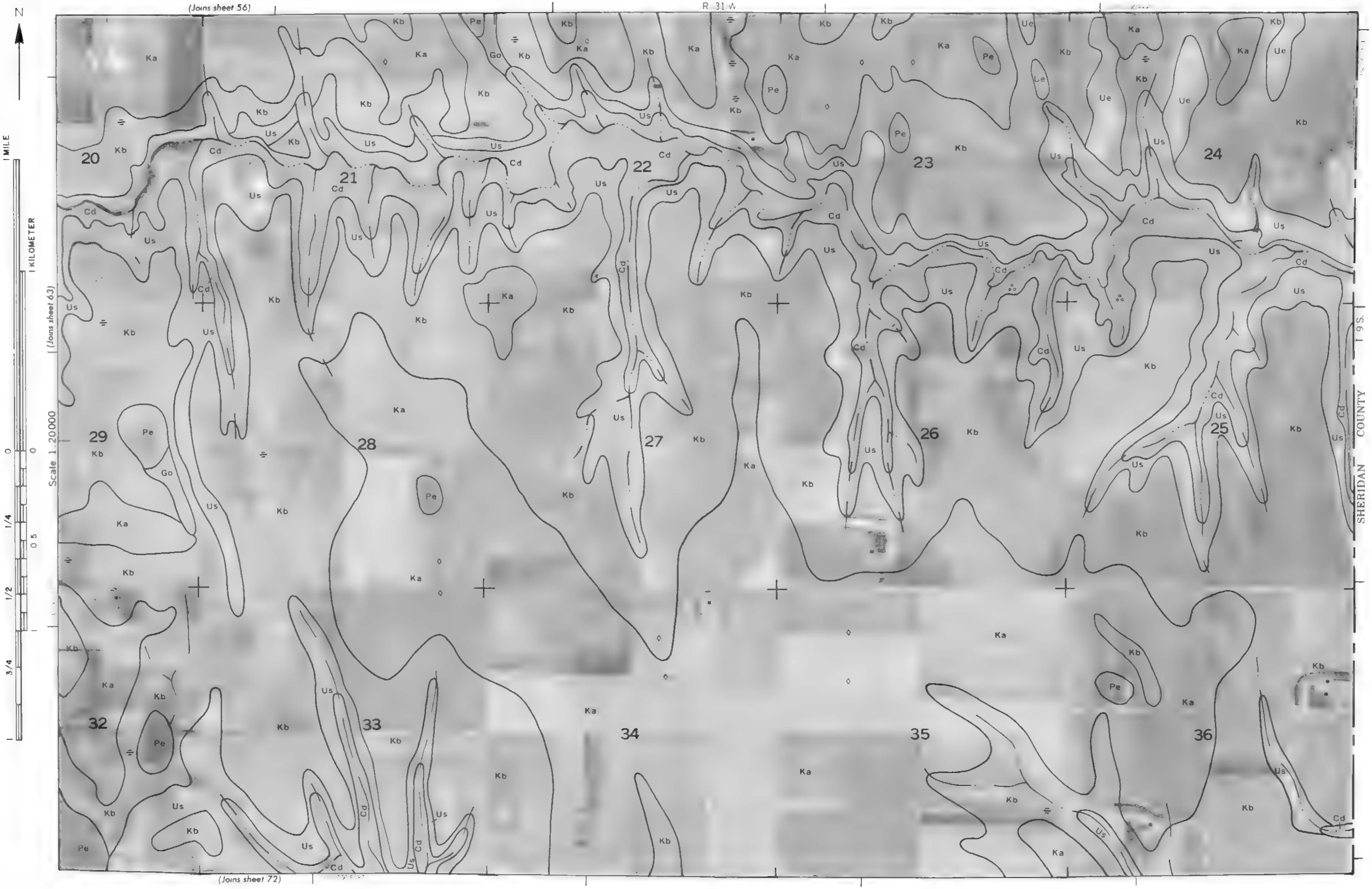

59
N
R. 35 W.
R. 34 W.
(Joins sheet 51)
(Joins sheet 60)
(Joins sheet 58)
(Joins sheet 67)
T. 9 S.
Solomon River
South Fork
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
10 000 FEET

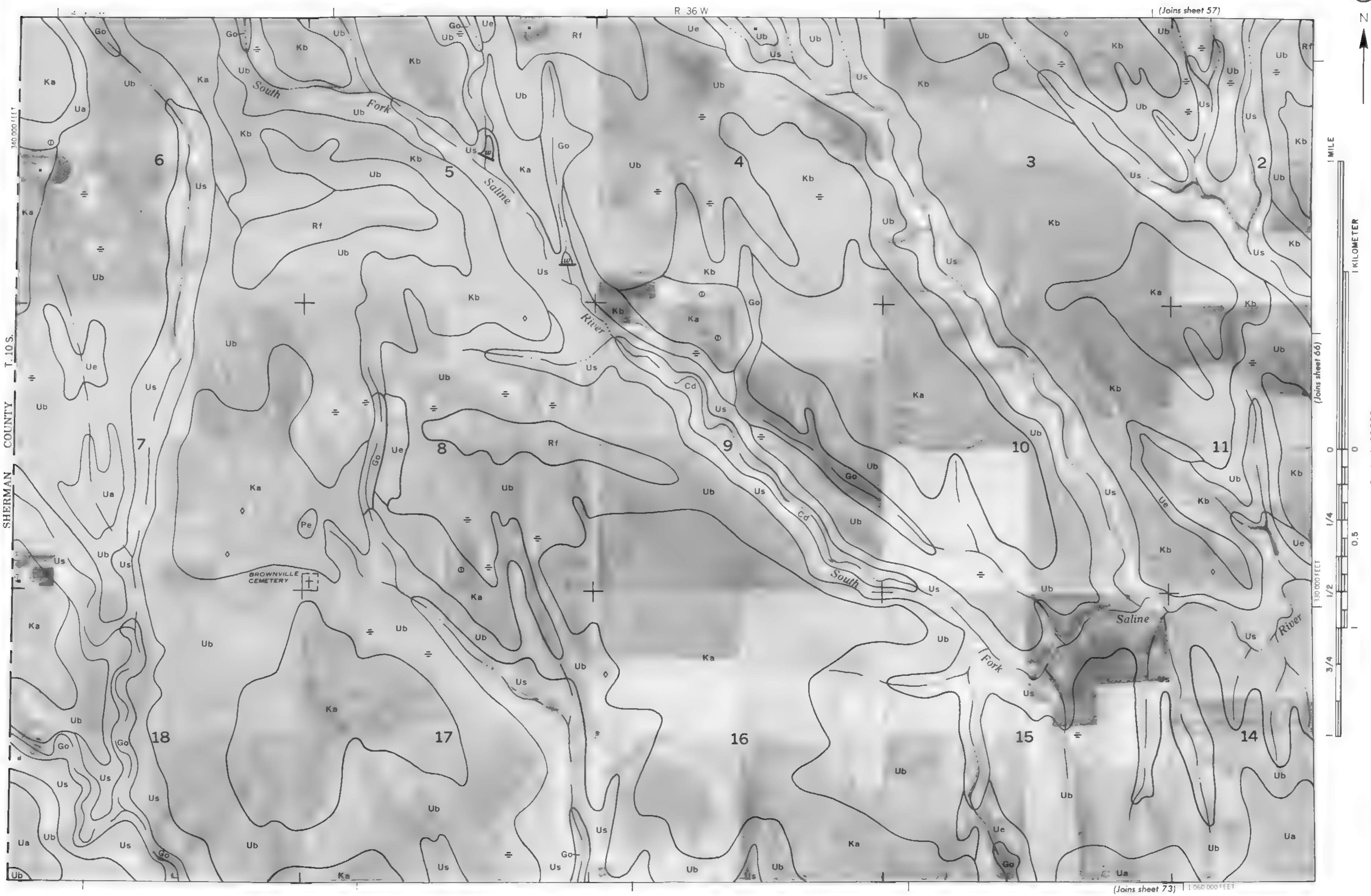

(Joins sheet 52)
R. 34 W
T. 9 S.
(Joins sheet 59)
(Joins sheet 61)
(Joins sheet 68)
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
South Fork Solomon R.
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Ka
Kb
Ub
Ue
Us
Go
Pe
Rf
Cd
Rx
Ha

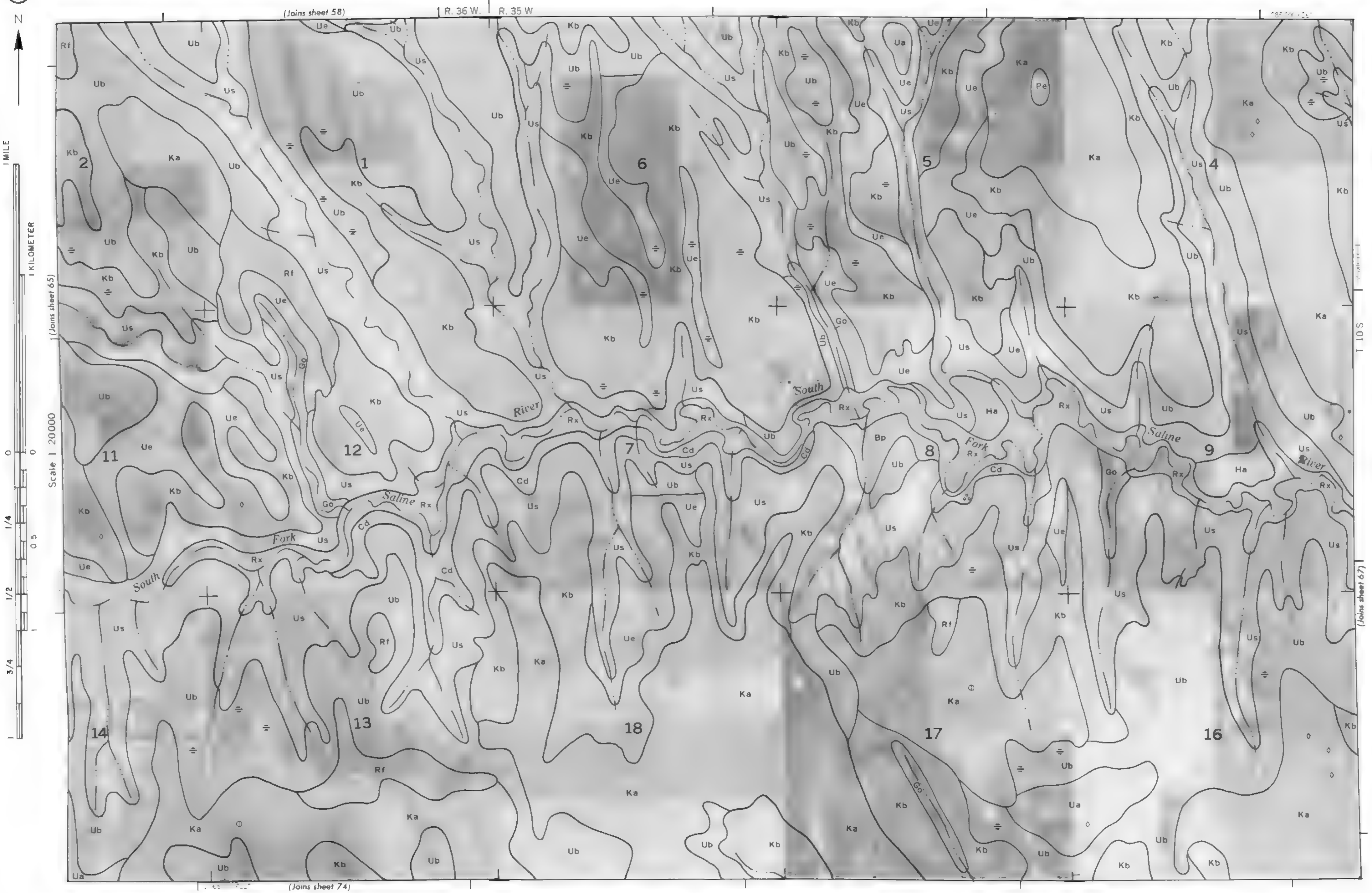

61
N
R 33 W
(Joins sheet 53)
(Joins sheet 60)
(Joins sheet 62)
(Joins sheet 69)
T 9 S
South Fork Solomon River
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
TOWNSHIP CEMETERY
1 MILE
1/4
1/2
3/4
1 KILOMETER
0
0.5
Scale 1:20000
Ka
Kb
Us
Ub
Rx
Go
Cd
Rf
Ue
Pe
Ua


62
N
(Joins sheet 54)
R 33 W
R 32 W
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 70)
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
South Fork Solomon River
UNION PACIFIC
70
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
Ka
Kb
Us
Ha
Rx
Cd
Ua
Ub
Rf
Pe
Pa
Go

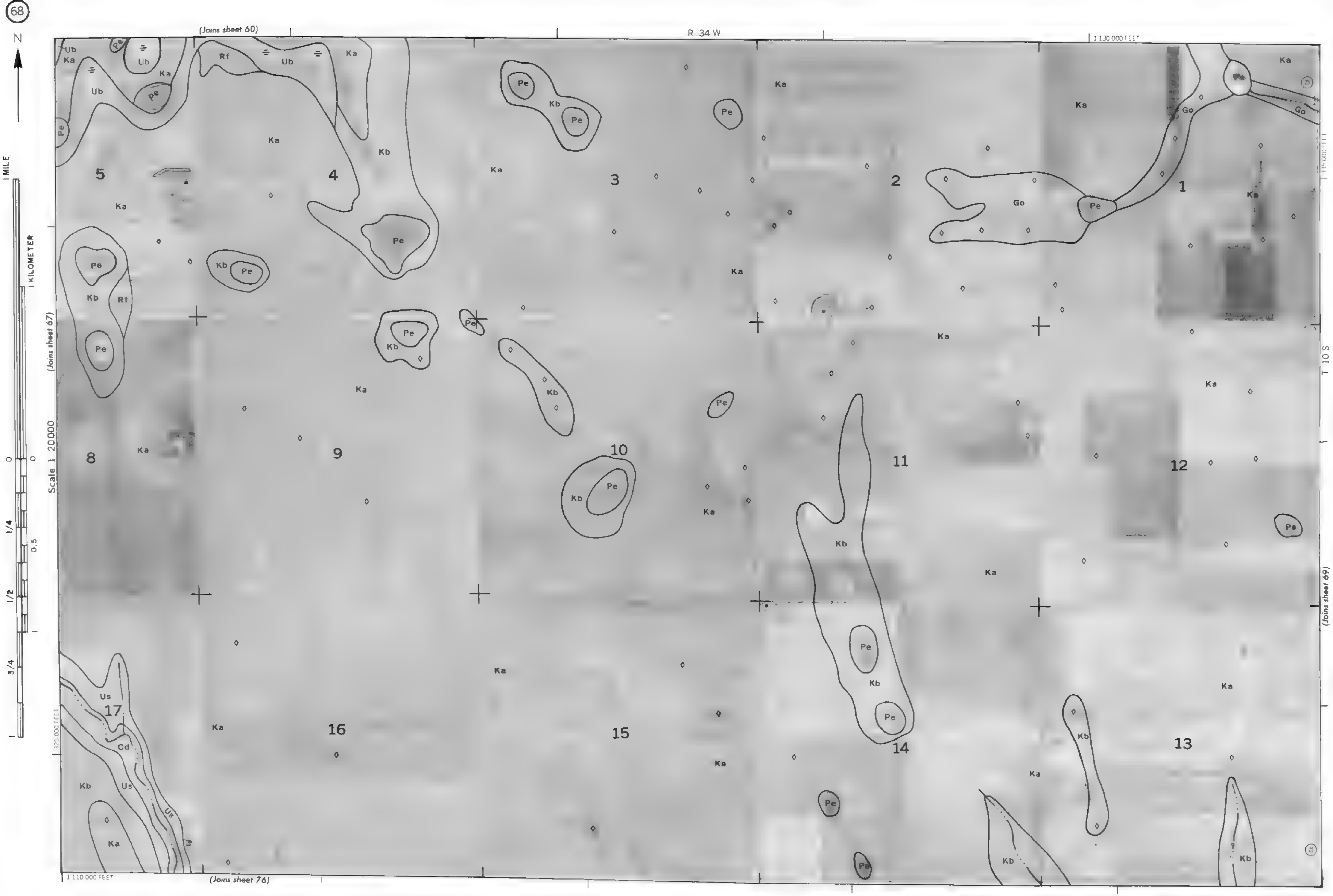

R 32 W
R 31 W
(Joins sheet 55)
(Joins sheet 62)
(Joins sheet 64)
(Joins sheet 71)
T 9 S
N
1 MILE
1 KILOMETER
Scale 1:20000
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
Ka
Kb
Go
Us
Cd
Ub
Pe
Ue

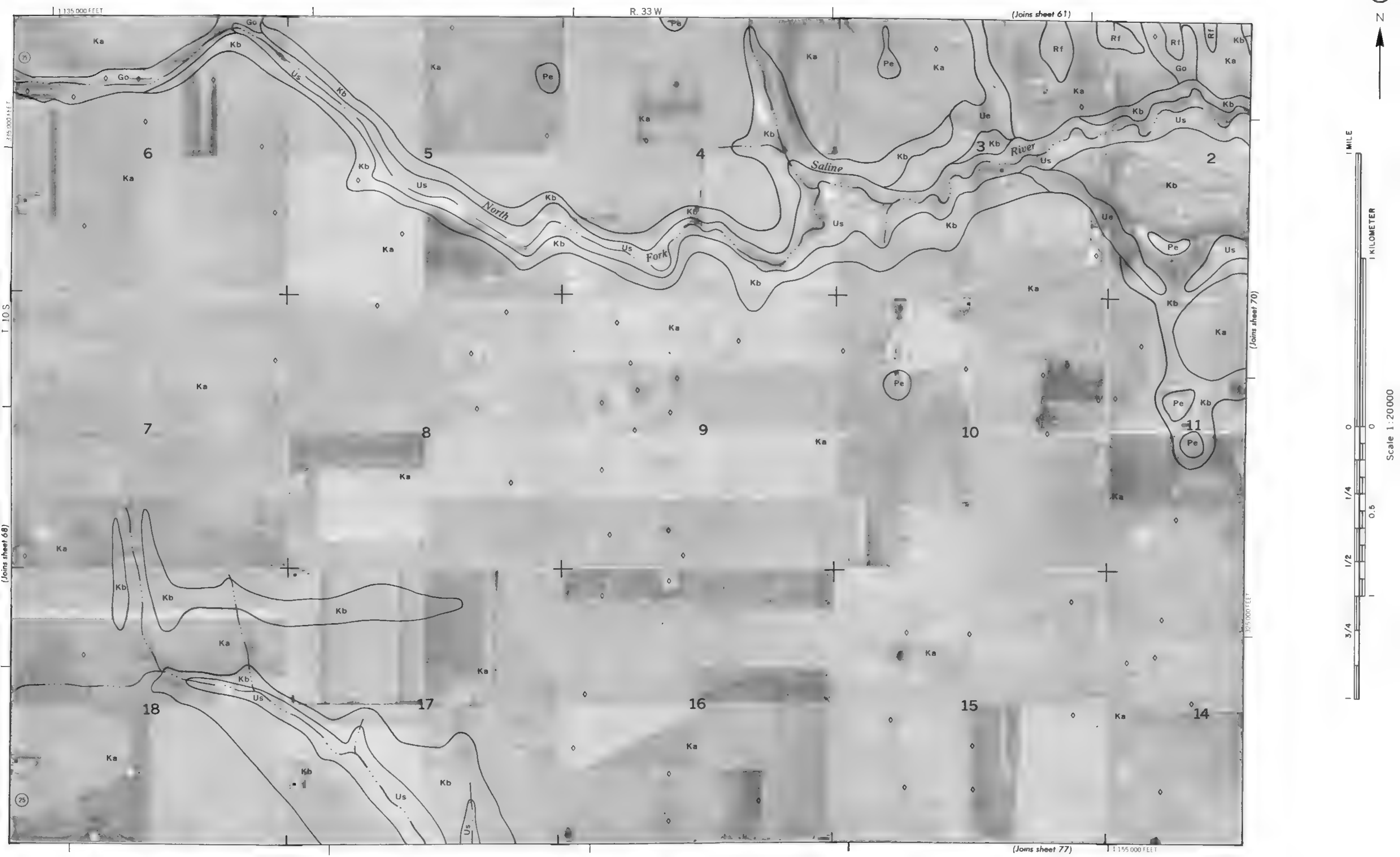

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 56)
R. 31 W.
(Joins sheet 63)
(Joins sheet 72)
T. 9 S.
SHERIDAN COUNTY
20
21
22
23
24
29
28
27
26
25
32
33
34
35
36


R. 36 W.
(Joins sheet 57)
(Joins sheet 66)
(Joins sheet 73)
T. 10 S.
SHERMAN COUNTY
South Fork Saline River
BROWNVILLE CEMETERY
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
340 000 FEET
330 000 FEET
1 060 000 FEET
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
Ka
Kb
Ua
Ub
Ue
Us
Go
Rf
Cd
Pe

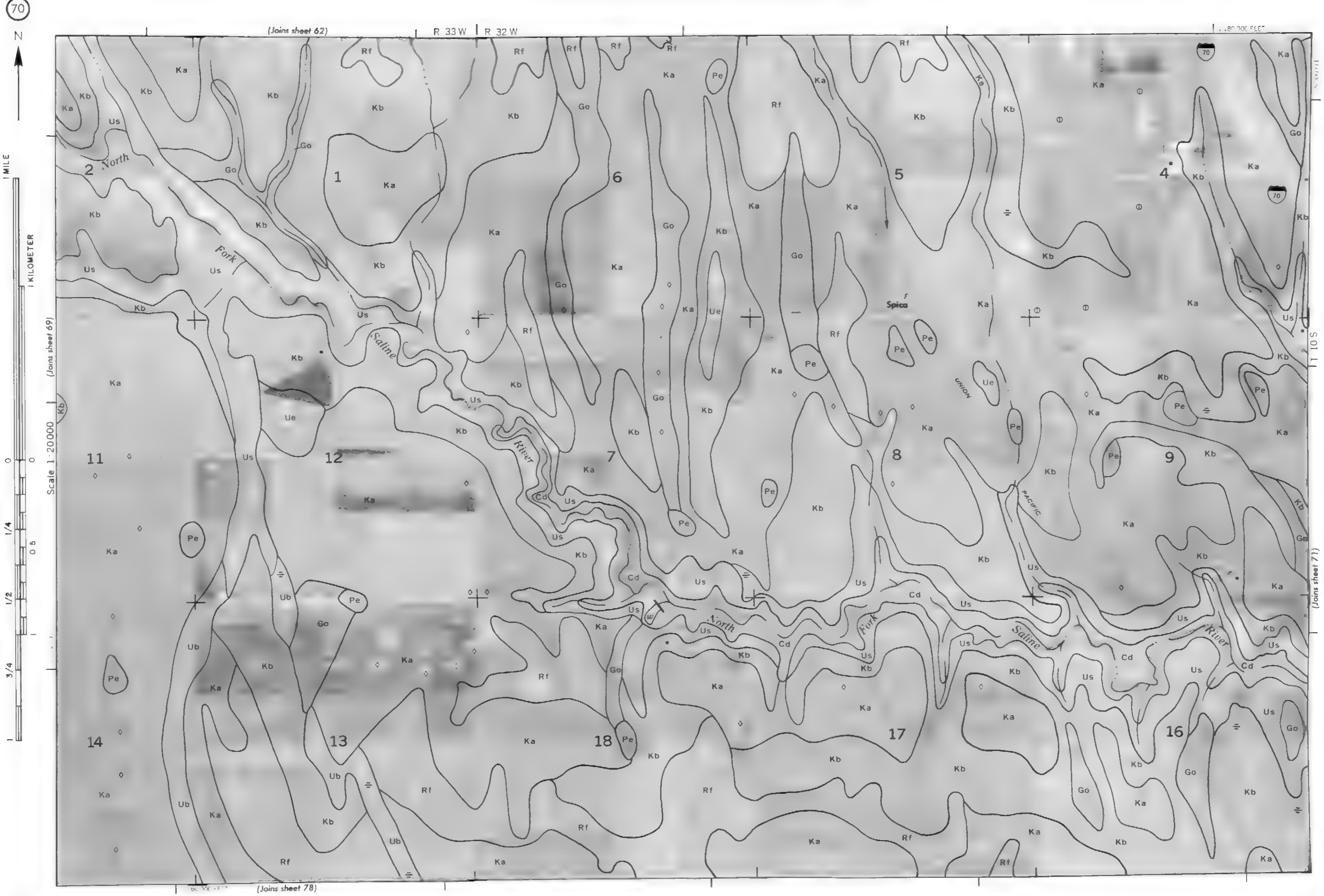

N
(Joins sheet 58)
R. 36 W.
R. 35 W
(Joins sheet 65)
(Joins sheet 67)
(Joins sheet 74)
T. 10 S.
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0
0.5
South Fork Saline River
South Fork
Saline
Fork
Saline River
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
Ka
Kb
Ub
Us
Ue
Ua
Rf
Rx
Cd
Go
Ha
Bp
Pe


67
N
(Joins sheet 59)
R 35 W
R 34 W
T 10 S
(Joins sheet 66)
(Joins sheet 68)
(Joins sheet 75)
South Fork
Saline
River
1 MILE
1 KILOMETER
Scale 1 20000

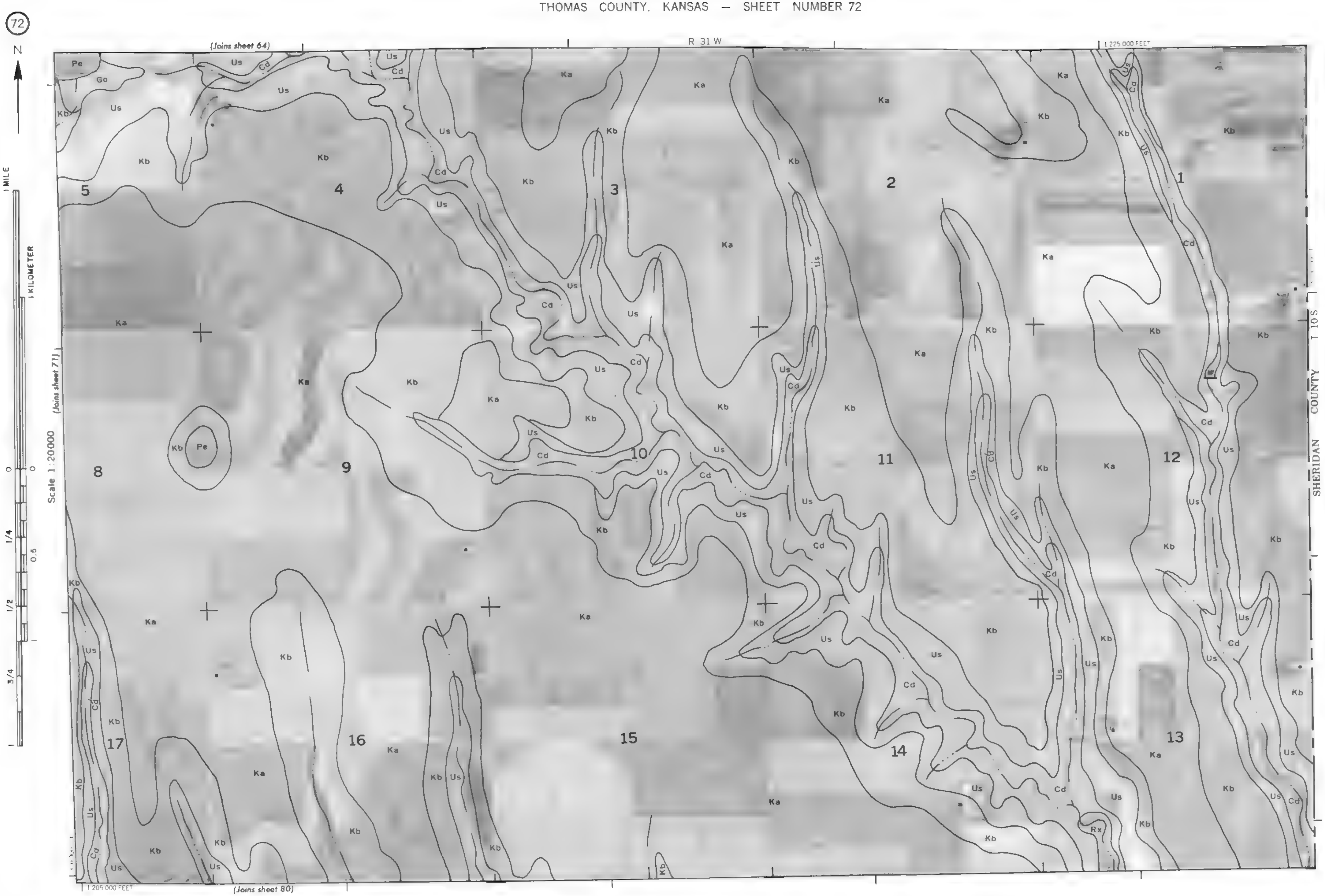

68
N
(Joins sheet 60)
R 34 W
(Joins sheet 67)
(Joins sheet 69)
(Joins sheet 76)
T 10 S
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
1 110 000 FEET
1 130 000 FEET
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
Ka
Kb
Pe
Ub
Rf
Go
Us
Cd

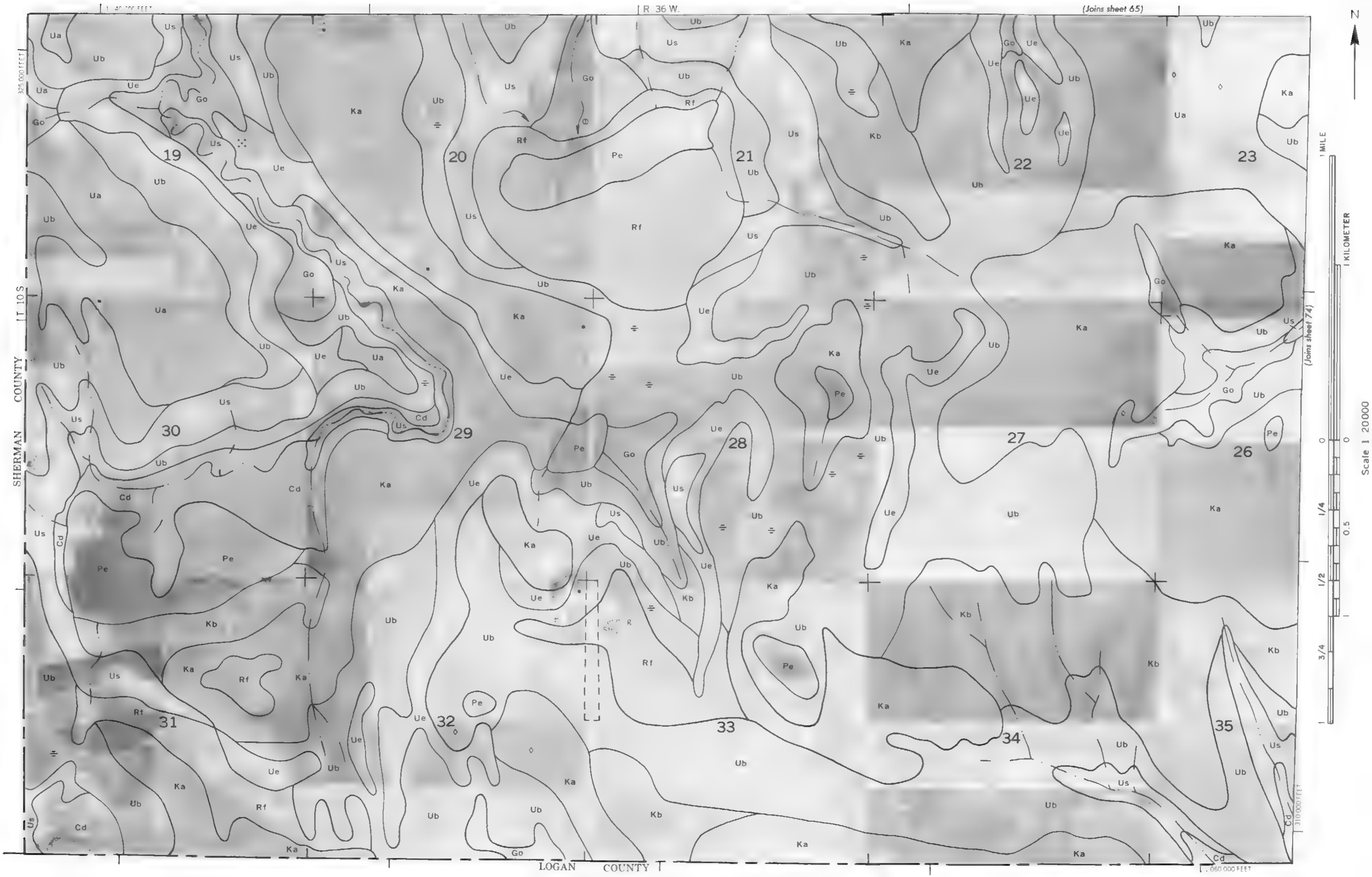


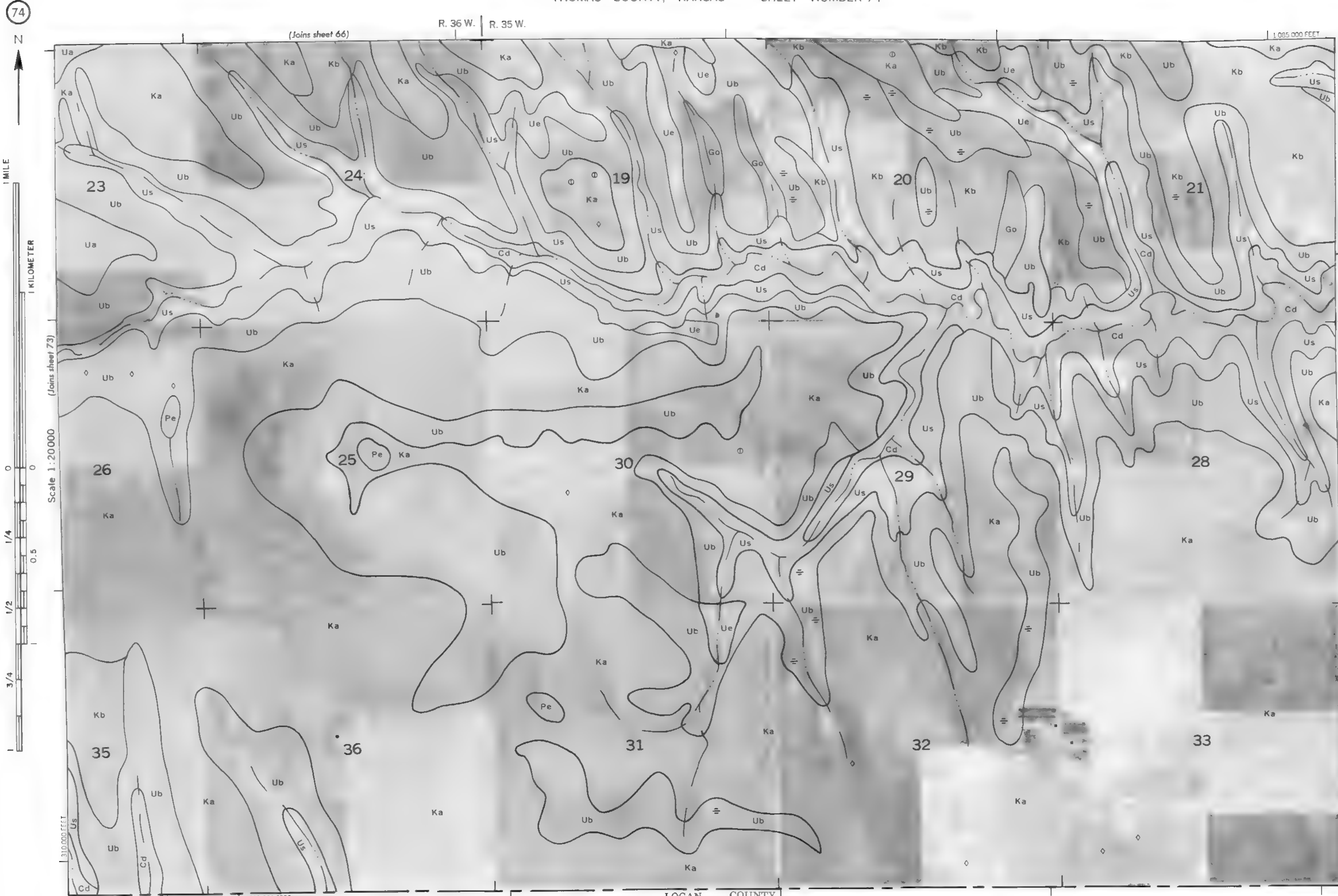
1 135 000 FEET
R. 33 W
(Joins sheet 61)
T. 10 S.
(Joins sheet 68)
(Joins sheet 70)
(Joins sheet 77)
1 155 000 FEET
325 000 FEET
North Fork
Saline River
Ka
Kb
Us
Ue
Go
Pe
Rf
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

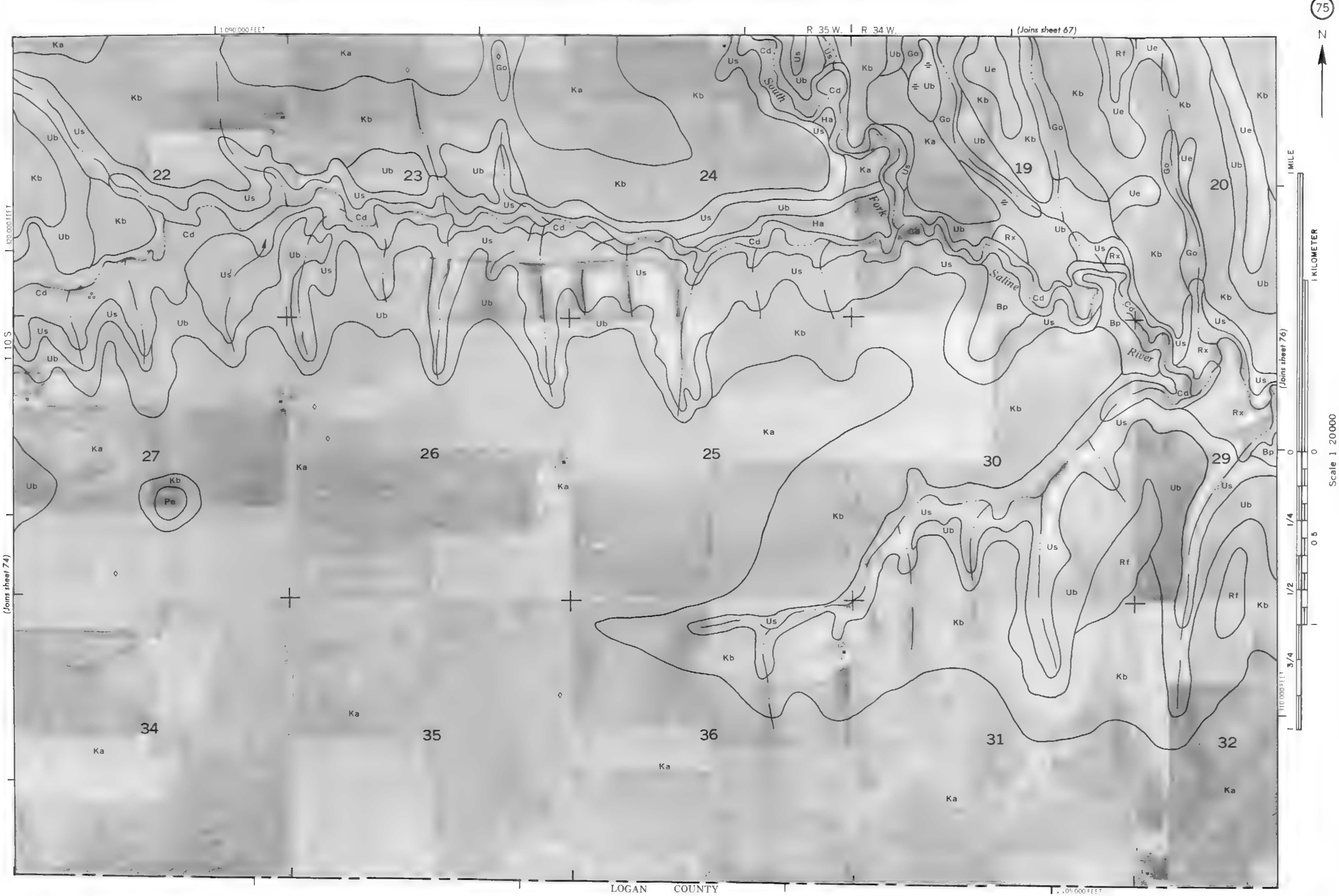

70
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:20000
(Joins sheet 62)
R 33 W
R 32 W
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 78)
T 10 S
70
North Fork Saline River
Spica
UNION PACIFIC
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
Ka
Kb
Us
Ue
Ub
Go
Rf
Pe
Cd

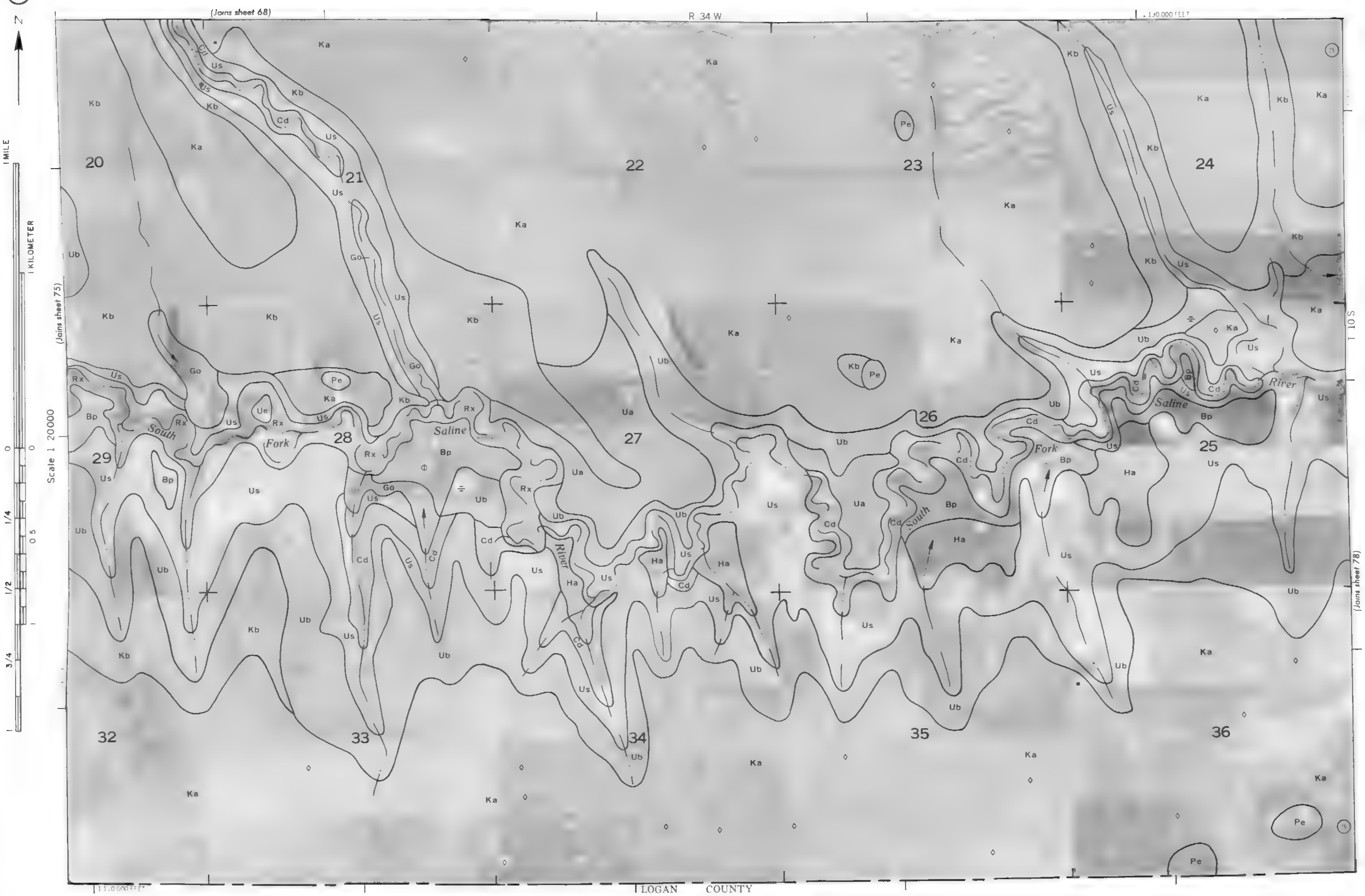

71
N
R. 32 W.
R. 31 W.
(Joins sheet 63)
(Joins sheet 72)
(Joins sheet 70)
(Joins sheet 79)
T. 10 S.
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
North
Fork
Saline
River
Ka
Kb
Us
Cd
Go
Pe
Ub
Ue
70
83

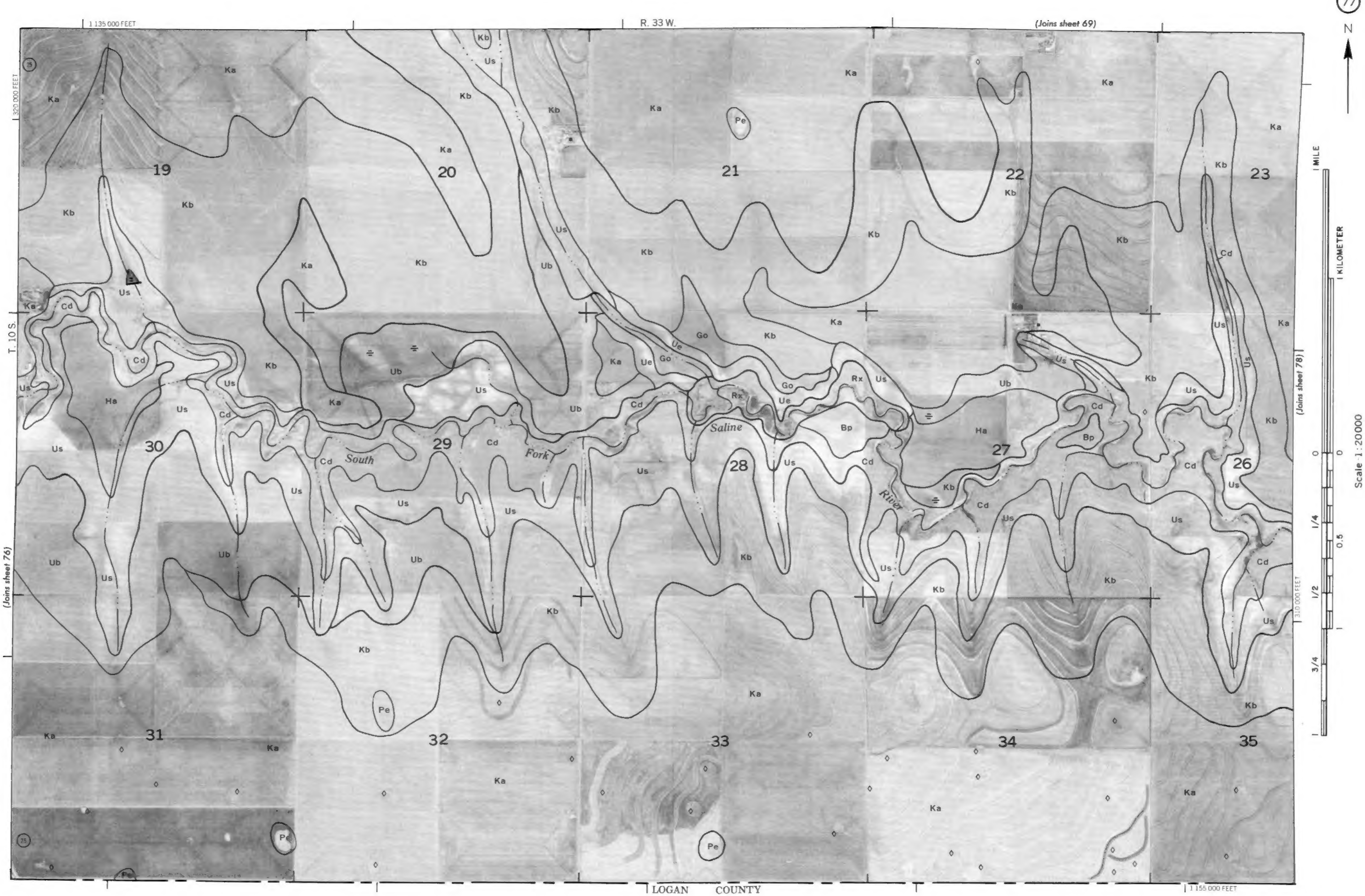

72
N
1 MILE
1 KILOMETER
0
1/4
0.5
1/2
3/4
1
Scale 1:20000
(Joins sheet 64)
R 31 W
1 275 000 FEET
(Joins sheet 71)
T 10 S
SHERIDAN COUNTY
(Joins sheet 80)
1 205 000 FEET
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
Pe
Go
Us
Cd
Ka
Kb
Rx


73
N
R. 36 W.
(Joins sheet 65)
(Joins sheet 74)
T. 10 S.
SHERMAN COUNTY
LOGAN COUNTY
325 000 FEET
310 000 FEET
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
1 MILE
1 KILOMETER
Scale 1: 20000


74
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 66)
R. 36 W.
R. 35 W.
1 085 000 FEET
T. 10 S.
(Joins sheet 73)
(Joins sheet 75)
310 000 FEET
1 065 000 FEET
LOGAN COUNTY
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

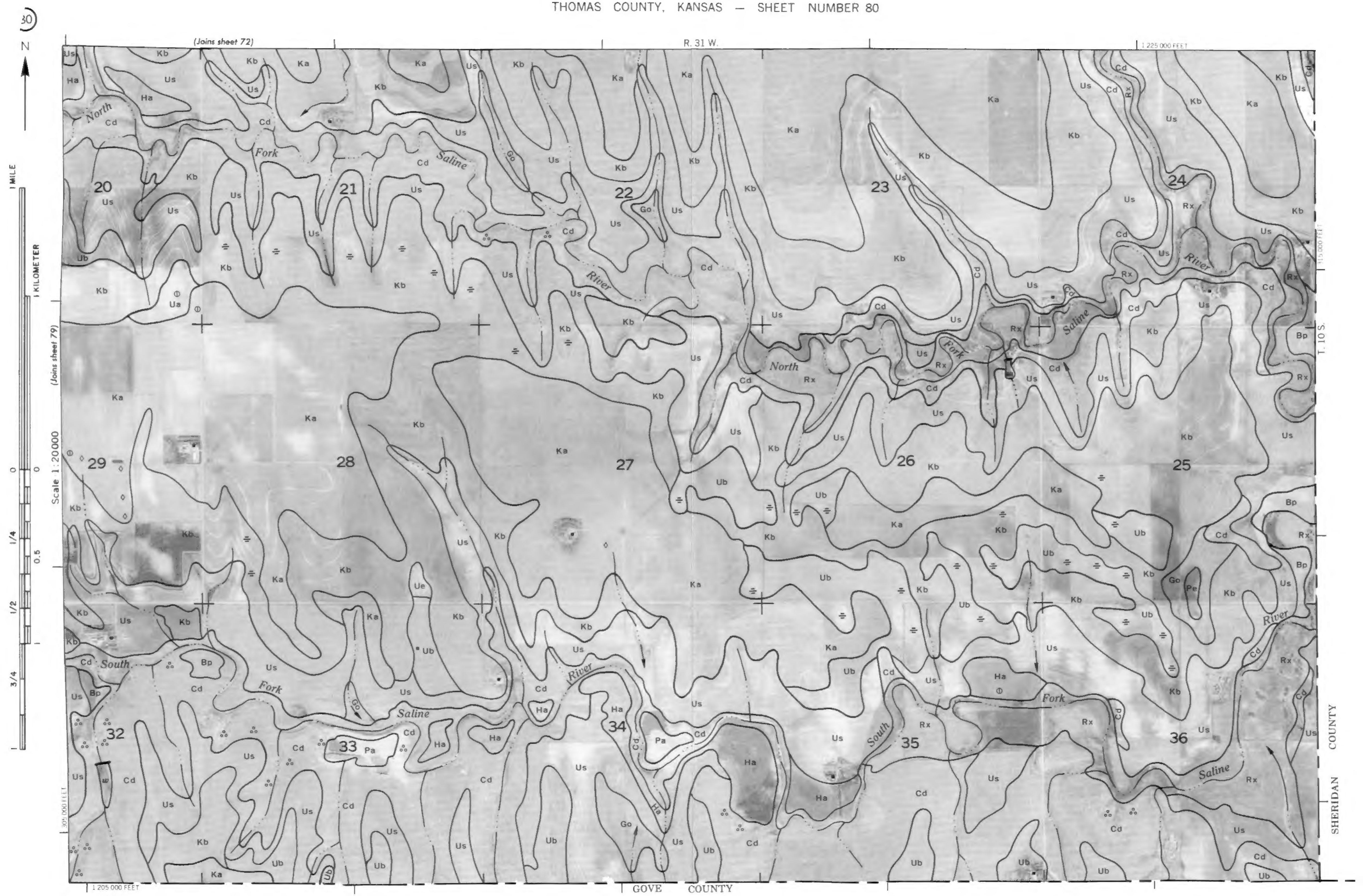

75
N
1 090 000 FEET
R 35 W.
R 34 W.
(Joins sheet 67)
(Joins sheet 74)
(Joins sheet 76)
320 000 FEET
310 000 FEET
1 050 000 FEET
T 10 S
South Fork
Saline River
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
LOGAN COUNTY
1 MILE
1 KILOMETER
Scale 1 20000
0
1/4
1/2
3/4
1
0
0.5
1


N
(Joins sheet 68)
R 34 W
(Joins sheet 75)
(Joins sheet 78)
T 10 S
1 MILE
1 KILOMETER
Scale 1 20000
0
1/4
1/2
3/4
0
0.5
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
South Fork Saline River
South Fork
Saline River
Ka
Kb
Us
Cd
Pe
Ub
Go
Rx
Bp
Ue
Ua
Ha
LOGAN COUNTY


77
N
1 135 000 FEET
R. 33 W.
(Joins sheet 69)
320 000 FEET
T. 10 S.
(Joins sheet 76)
(Joins sheet 78)
310 000 FEET
1 155 000 FEET
LOGAN COUNTY
South Fork Saline River
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35
Ka
Kb
Us
Ub
Ue
Cd
Ha
Go
Rx
Bp
Pe
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000

78
N
(Joins sheet 70)
R. 33 W.
R. 32 W.
1 180 000 FEET
UNION PACIFIC
320 000 FEET
T. 10 S.
(Joins sheet 77)
(Joins sheet 79)
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
310 000 FEET
1 160 000 FEET
LOGAN COUNTY
South Fork Saline River
South Fork Saline River
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36


79
N
1 185 000 FEET
320 000 FEET
R. 32 W.
R. 31 W.
(Joins sheet 71)
(Joins sheet 80)
(Joins sheet 78)
T. 10 S.
North Fork Saline River
South Fork Saline River
UNION PACIFIC
OAKLEY CEMETERY
305 000 FEET
1 200 000 FEET
LOGAN COUNTY
GOVE CO
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
83
70
Ka
Kb
Ua
Ub
Ue
Us
Cd
Ha
Pa
Rx


80
N
(Joins sheet 72)
R. 31 W.
1 225 000 FEET
(Joins sheet 79)
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
North Fork Saline River
South Fork Saline River
T. 10 S.
315 000 FEET
305 000 FEET
1 205 000 FEET
GOVE COUNTY
SHERIDAN COUNTY
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36